

The
ANDERSON
ARITHMETIC

BOOK TWO

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THE
ANDERSON ARITHMETIC
BOOK TWO

BY

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WEST CHESTER, PENNSYLVANIA

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PREFACE

IN the preparation of this series of arithmetics the author has utilized not only the conclusions reached by his own study and investigations and by his experience of many years in teaching and supervising the teaching of arithmetic, but also the results of modern school practice, experiments, and investigations contributed by many who have labored in this field to discover the inherent difficulties of the subject itself, to improve methods of instruction, and to eliminate useless subject matter. An examination of these books will reveal their adaptation to modern courses of study and methods of instruction.

Book Two, the second of the series, when used in connection with *Book One*, furnishes the elements of arithmetic. The subject matter of this book has been chosen and organized in harmony with modern educational thought and successful elementary school practice. The emphasis upon the fundamental operations begun in *Book One* is continued in this book with particular stress upon their more difficult phases. Experiments have shown this emphasis to be necessary. The continued use of the tests and accuracy and speed drills will reveal the differences, the achievements, and the progress of the various pupils, and thereby enable the teacher to give the needed individual aid and encouragement. Investigation has shown that children's knowledge of their previous record of attainment, combined with a desire to surpass this record, is the greatest factor contributing to improvement.

Part One consists of four chapters and an extensive general review. Chapter I, which treats of fundamental processes in-

volving integers, and Chapter II, which deals with common fractions, are designed, through their carefully organized subject matter and comprehensive drills and tests, to develop the skill now demanded by prevailing standards. Chapter III consists of comparatively simple treatment of decimals, which lays the foundation for the work of decimals and provides an everyday working knowledge of the simplest phases of the subject. Chapter IV provides a thorough review of measures taught in earlier grades and calls forth the activities of the pupil by making such applications of them as will impress him with their significance and the utility outside of the classroom. The purpose of the general review is manifestly to give the pupil practice in the discriminative use of what he has learned in the chapters just completed.

Part Two consists of five chapters and a comprehensive general review. The first two chapters provide material for reviewing, testing, and extending the knowledge and skill acquired in the use of the fundamental processes with integers and fractions. The treatment of decimals in Chapter III will give the pupil a working knowledge of the practical aspects of this important subject. Decimals are also closely correlated with percentage in its simplest phases and applications in Chapter IV. Chapter V, which deals with measures, is designed through its reviews to make permanent such knowledge of tables as every intelligent citizen should have, and to give ample opportunity for the application of these facts to problems that are closely related to the life of the pupil in the home, the school, and the community. The final review provides sufficient material to enable the teacher to bring before the class the leading phases of the work of the chapters preceding.

ROBERT F. ANDERSON

CONTENTS

PART I

CHAPTER I. FUNDAMENTAL OPERATIONS

	PAGE		PAGE
Reading and Writing Numbers	1	Cash Accounts	21
Addition	6	Multiplication	22
United States Money	11	Division	30
Subtraction	14	Review — Tests and Problems	38

CHAPTER II. FRACTIONS

Review and Preparation . . .	42	Multiplication	65
Terms of a Fraction	48	Division	75
Reduction	49	Comparison	81
Addition and Subtraction . .	56	Review — Tests and Problems	82

CHAPTER III. DECIMALS

Reading and Writing Decimals	89	Multiplication	100
Reduction	93	Division	104
United States Money	94	Bills	109
Addition	96	Thrift	112
Subtraction	98	Review — Tests and Problems	115

CHAPTER IV. MEASURES

Review and Extension of Liquid and Dry Measure, Measures of Weight, Time, and Length, Square and Cubic Measure .	118	Addition, Subtraction, Multi- plication, and Division of Compound Amounts . . .	133
		General Review	137

PART II

CHAPTER I. FUNDAMENTAL OPERATIONS

Reading and Writing Large Numbers	145	Factoring, Divisibility, and Cancellation	153
Accuracy and Speed Tests in Fundamental Operations . .	147	Problems Involving the Four Fundamental Processes . .	157

CHAPTER II. FRACTIONS

	PAGE		PAGE
Review of Addition, Subtraction, Multiplication, and Division of Fractions . . .	160	Complex Fractions	1
		Problems Involving Fractions . .	1

CHAPTER III. DECIMALS

Reading and Writing Decimals	172	United States Postage	1
Reduction	177	Thrift	1
Addition and Subtraction . .	178	Farm Projects	1
Multiplication	180	Review — Tests and Problems	1
Division	184	Review of Whole Numbers, Fractions, and Decimals . .	2
Reducing Common Fractions to Decimals	188		

CHAPTER IV. PERCENTAGE

Meaning of Per Cent	211	The Three Problems of Percentage	2
Equivalents — Per Cent, Decimal, and Fractional . . .	212	Review	2
Finding a Given Per Cent of a Number	213	Trade Discount	2
Finding a Number When a Per Cent of It Is Given . . .	217	Profit and Loss	2
Finding What Per Cent One Number Is of Another . .	219	Commission	2
		Interest	2
		Promissory Notes	2
		Checks and Receipts	2

CHAPTER V. MEASURES

Review and Use of Tables . .	244	Problems in Home Gardening .	2
Reduction of Compound Amounts	247	Plane Surfaces — Triangle, Quadrilateral, Parallelogram, and Trapezoid	2
Addition and Subtraction of Compound Amounts . . .	248	Carpeting	2
Multiplication and Division of Compound Amounts . . .	251	Plastering and Painting . . .	2
Angles and Parallel Lines . .	252	Measuring Lumber	2
Plane Surfaces — The Square .	253	Solids	2
The Rectangle	254	Wood Measure	2
Problems about Building Lots .	257	Projects	2
		General Review	2

BOOK TWO — PART ONE

CHAPTER I

FUNDAMENTAL OPERATIONS

Reading and Writing Numbers. You have already had practice in counting and in reading and writing numbers, but you must make sure that you can use readily what you have learned. You are going to learn still more about numbers, and in this study of arithmetic, in your other studies, and in the various things you do, whether in work or play, you will often be called on to count and to read and write numbers. You should be able to do so quickly and correctly.

THE USES OF NUMBERS

1. Tell the class of two instances in which, during the summer vacation, you found it convenient to be able to count; to read or write numbers; to use numbers in any other way.
2. Tell the class of instances in which, during the summer vacation, you noticed that others found it necessary to use numbers.
3. Name five occupations which men or women follow in your neighborhood, and state one use which a person in each occupation has for numbers.

COUNTING. READING AND WRITING NUMBERS OF FOUR FIGURES OR LESS

1. How far can you count in a minute, counting *one, two, three*, and so on? Time yourself.
2. Find out how many times your pulse beats in a minute.

3. Name the ten figures which are commonly used in writing numbers.

4. What name is given to ten ones?

5. Beginning at ten write in figures and name the nine tens.

6. Count by tens to one hundred; from one hundred to ten

7. Name the whole numbers of two figures each which end in 1; 2; 3; 4; 9.

8. Write in figures and name the first nine hundreds.

9. Write on the blackboard and read six numbers of three figures each.

10. Name something that costs about 100 dollars.

11. Tell the class of some instance in which you have seen a number of three figures used.

12. What name do you give to ten hundreds?

13. Count by thousands to nine thousand; write each of these

14. Name something that costs about 1000 dollars.

15. Can you name anything that costs about 5000 dollars?

16. Write on the blackboard and read six numbers of four figures each.

17. Find in newspapers or magazines three numbers of four figures each. Write them on the blackboard to-morrow and tell the class how they were used.

18. Name some uses which you have had for the numbers on this page.

Place Value. In the number 475, the 5 is in *units' place* and means 5 *ones*; the 7 is in *tens' place* and means 7 *tens*; the 4 is in *hundreds' place* and means 4 *hundreds*. We see from this illustration that:

Each figure in a number has a value which depends on its place in that number.

PLACE VALUE

1. Tell what each figure stands for in the number 76; 48; 92.
2. Write and read the number made up of 6 tens and 7 units; of 4 tens and 2 units.
3. Tell what each figure stands for in the number 289; 805; 375.
4. Write and read the number made up of 3 hundreds, 6 tens, and 4 units; 4 hundreds and 2 tens; 5 hundreds and 2 units; 1 hundred and 8 tens.
5. What does each figure stand for in the number 7856? 8031? 6804? 6004?
6. Write and read the number made up of 4 thousands, 6 hundreds, 3 tens, and 2 units; 5 thousands, 4 tens, and 9 units; 6 thousands, 4 hundreds, and 8 units; 6 thousands and 5 units.
7. Write and read six other numbers of four figures each and name the number for which each figure in the numbers stands.

Uses of Large Numbers. The use of large numbers has rapidly increased during recent years. You will frequently be called upon to read and write such numbers. You will meet them in your studies and see them printed in newspapers and magazines and elsewhere. You should learn to read them correctly and rapidly.

Thus, in a newspaper item the statement was made that the American public is using nearly 2,500,000,000 (*two billion five hundred million*) gallons of gasoline each year for running automobiles.

Periods. When more than four figures are used to express a whole number, such as the one above, they are usually separated, as far as possible, into *groups* or *periods* of three figures each, beginning at the right, so that the number may be more easily read. In each period there are three orders or places, *units*, *tens*, and *hundreds*.

In the following table name the periods. How many orders are there in each period? Name the orders in each period.

Billions 4th period	Millions 3d period	Thousands 2d period	Units 1st period
2,	3 0 0,	0 4 8,	6 5 8
Billions	Hundred-millions Ten-millions Millions	Hundred-thousands Ten-thousands Thousands	Hundreds Tens Units

The number in the table is read *two billion three hundred million forty-eight thousand six hundred fifty-eight*.

READING AND WRITING LARGE NUMBERS

Read, then write from dictation :

1.	2.	3.	4.	5.
7826	83,467	327,684	1,567,637	1,000,000,000
4039	56,045	100,832	2,765,872	3,375,000,000
5602	20,932	567,200	8,503,002	3,762,400,000
8560	48,606	230,004	7,040,670	1,001,100,000

TO THE TEACHER. Confusion is avoided by dictating as telephone numbers are given. Thus, in dictating 14,270, say *one-four-two-seven-o*.

6. Write four numbers of five figures each; four numbers of six figures each. Separate each number into periods and read it.

7. Write four numbers of seven figures each; four numbers of eight figures each. Separate into periods and read each number.

8. Read this sentence taken from a magazine: "The year loss to farm crops in the United States caused by insects is more than 1,104,500,000 dollars."

9. What was the population of your state by the last census?

103. Read the following, taken from a magazine: "Do you know of a more efficient mechanism than the heart, pumping at the rate of 15 gallons per hour for 613,200 hours during the average lifetime of a person, at the rate of 4320 strokes per hour? This means 2,649,024,000 strokes in the average lifetime, or to put it another way, 9,198,000 gallons in a lifetime."

Roman Numerals. As you will meet Roman numbers in your studies, and elsewhere, you should know how to read and write them accurately and with ease.

1. $I=1$; $V=5$; $X=10$; $L=50$; $C=100$; $D=500$; $M=1000$.
2. $XX=20$. Repeating a letter repeats its value. (Give other examples.)
3. $XL=40$. If a letter is written before another of greater value, the difference of their values is expressed. (Give other examples.)
4. $DL=550$. If a letter or combination of letters is written after a letter of greater value, the sum of the values is expressed. (Give other examples.)
5. $MCXI=1111$. In writing numbers of four or more orders, hundreds are written after thousands, tens after hundreds, and units after tens. (Give other examples.)

ROMAN NUMERALS

1. Read the page numbers of the front pages of this book.
2. Write by the Roman method the numbers from: 1 to 24; 45 to 68; 80 to 100.
3. Name four uses of Roman numerals.
4. Write in Roman numbers: 1789; 1917; 1803; 1926; 1820; 1930.

5. Read: XXIV; XLI; XLIV; XCV; MCM; MCMXXIV; MCDXCII.

6. Bring to class any number which you have seen written in Roman numerals on any building in your town or elsewhere.

Addition. Uniting two or more numbers into one number (the sum) is called *addition*.

Units. Any standard which is used in measuring or counting is called a *unit*.

Amounts. Such expressions as \$5, 2 bushels, 3 hours, are called *amounts*. In \$5, the *unit* is \$1; in 2 bushels, the *unit* is 1 bushel; in 3 hours, the *unit* is 1 hour. In the numbers 1, 2, 3, and so on, the *unit* is 1. Amounts that are composed of the same kind of units, as 5 cents and 3 cents, are called *similar amounts*. Similar amounts, and only such, can be added; the sum is similar to the amounts added.

During this year you should better the record you made last year in working examples. You will be aided in doing so by reviewing last year's work in addition.

ACCURACY AND SPEED TEST

Can you name at sight the correct sums in these 45 examples in less than 30 seconds? Practice until you can do so. Even after you have attained this record, continue to drill on these combinations

2	1	2	1	4	5	1	3	2	3	4	1	6	3	2
5	8	6	1	4	7	3	9	2	5	6	9	8	6	7
2	5	1	3	4	1	5	2	4	1	7	1	8	2	6
4	8	5	7	5	4	5	9	8	7	9	2	8	3	9
3	2	4	6	4	1	5	7	4	5	3	6	7	9	8
3	8	9	6	7	6	9	7	3	6	8	7	8	9	9

TO THE TEACHER. Much drill should be given here in counting by 2's, 3's, 4's, and so on to 9's, beginning at different numbers.

To check addition, add again in the same way or add a second time in the reverse order.

As an aid to accurate and rapid work in addition, you should be able to name at sight the sum obtained by adding any number of one figure to any number of two figures.

5	17	Begin by adding 5 to each number in the right-hand column and say answers only. Thus, <i>22, 37, 61</i>, and so on. Then add 2 to each number in the right-hand column; then 1, and so on, until you have added each number in the left-hand column to each number in the right-hand column.
2	32	
1	56	
4	14	
3 to	75	
7	43	

8	68	TO THE TEACHER. Sets of cards similar to this, one card for each pupil, may be made and used to advantage in teaching examples of this type. The last figure in each number to the right should be different in each set from that here shown, and different from that of the other sets.
6	21	
9	89	

2	4	5	3	8	6	4	5	7	4	6	9	7	6	8
3	7	3	2	3	8	2	6	8	8	6	8	8	8	9
1	3	5	6	7	1	7	7	9	7	8	9	9	7	9
1	2	5	4	5	9	6	4	6	9	9	8	9	9	9

3. Practice until you can add these 15 columns in $2\frac{1}{2}$ minutes. Do not copy the examples. Write the answers on a sheet of paper placed beneath them. Add upwards; check by adding downwards.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>
2	4	8	6	4	3	7	5	4	0	9	5	2	1
3	5	3	7	8	8	5	4	0	8	9	3	8	9
1	3	5	4	5	6	5	3	9	7	9	2	6	8
4	2	9	3	3	8	6	7	3	7	2	7	6	7
7	0	2	6	7	0	7	3	4	6	3	3	6	5
5	8	2	7	4	2	8	9	8	6	5	1	7	4
9	6	8	6	8	9	7	6	7	9	5	1	7	7
4	4	3	5	7	8	8	9	6	6	5	8	6	3
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>

ACCURACY AND SPEED TEST

1. In how much less than 3 minutes can you get the 15 sums required below? Do not copy the examples. Check.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>
7	3	6	3	1	2	5	6	8	5	1	8	6	5
4	5	6	5	6	5	7	6	7	6	2	7	4	4
3	4	0	8	9	7	6	8	7	8	4	4	3	9
7	1	7	6	4	4	3	7	8	8	3	3	7	6
5	3	5	9	3	3	8	9	9	8	5	5	9	8
4	6	2	2	8	8	5	0	9	3	9	1	9	5
1	2	3	4	5	6	7	8	9	3	6	9	8	7
7	9	5	8	6	7	9	6	6	9	8	6	9	8
8	6	9	7	9	6	5	7	8	6	7	9	8	7
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>

2. Add at sight; name sums only:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
20	70	25	60	74	11	42	3
<u>30</u>	<u>20</u>	<u>40</u>	<u>32</u>	<u>20</u>	<u>34</u>	<u>15</u>	<u>2</u>

	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
2	44	56	24	<i>Thus, think:</i>	39	28	35
3	<u>33</u>	<u>22</u>	<u>37</u>	<i>37, 57, 61</i>	<u>21</u>	<u>43</u>	<u>25</u>
2	12	14	25	36	35	29	36
8	<u>29</u>	<u>37</u>	<u>47</u>	<u>48</u>	<u>46</u>	<u>43</u>	<u>55</u>
9	39	47	54	58	47	48	58
7	<u>58</u>	<u>36</u>	<u>39</u>	<u>29</u>	<u>39</u>	<u>37</u>	<u>38</u>

3. Make 20 examples like those in example 2, and add at sight.

How to Add Large Numbers. Add 748, 356, and 467.

748	<i>In practice think:</i> 7, 13, 21 (write 1)
356	2, 8, 13, 17 (write 7)
467	1, 5, 8, 15 (write 15)
<u>1571</u>	The sum is 1571. <i>Check:</i> Add downwards.

ACCURACY AND SPEED TEST

Add and check. Time yourself in working these 12 examples; then work them again and try to better your first record. Do not copy the examples.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	54	42	57	49	57	95
	26	48	32	33	68	87
	30	73	28	65	35	39
	<u>37</u>	<u>54</u>	<u>71</u>	<u>74</u>	<u>76</u>	<u>48</u>
2.	30	47	38	54	84	99
	44	29	49	36	37	87
	20	32	65	48	68	78
	42	40	37	67	26	56
	17	85	27	75	42	88
	<u>18</u>	<u>57</u>	<u>76</u>	<u>89</u>	<u>79</u>	<u>93</u>

Add, and tell the sums; add upward, then across :

$$\begin{array}{r}
 3. \quad 32 + 17 + 14 = \\
 \quad 24 + 46 + 72 = \\
 \quad 97 + 35 + 41 = \\
 \quad 86 + 45 + 79 =
 \end{array}$$

$$\begin{array}{r}
 4. \quad 2745 + 325 + 430 = \\
 \quad 405 + 320 + 735 = \\
 \quad 114 + 428 + 30 = \\
 \quad 12 + 48 +
 \end{array}$$

ACCURACY AND SPEED TEST

Practice until you can add any 8 of these examples in minutes. Check results.

1.	2.	3.	4.	5.	
746	205	431	232	813	5
231	533	269	459	796	9
422	356	577	671	629	4
365	629	798	818	582	3
478	461	942	197	434	2
124	197	154	343	376	1
346	918	836	524	948	8
274	740	663	765	264	6
<u>521</u>	<u>874</u>	<u>385</u>	<u>986</u>	<u>155</u>	<u>7</u>

7.	8.	9.	10.	11.	
835	486	148	487	314	6
164	794	484	856	521	8
607	178	753	952	939	9
548	309	262	563	652	7
479	663	925	844	743	4
786	915	837	358	478	7
355	736	589	776	887	8
233	558	698	287	365	8
<u>992</u>	<u>867</u>	<u>759</u>	<u>987</u>	<u>799</u>	<u>5</u>

TO THE TEACHER. The answers to examples 1 to 12, page 10, may be written on a loose sheet of paper placed under them. However, if it is convenient to do so, these examples should be mimeographed in order that each pupil may write the answers directly under them. Time the pupils. Aim first to secure correct answers, and then to secure speed. Change the order of the examples frequently and dictate others like them.

United States Money. *Five dollars* may be written \$5 or \$5.00; *five cents* may be written 5c., 5¢, 5 ct., \$0.05, or \$.05. *8 dollars 42 cents* may be written \$8.42. The point between the number of dollars and the number of cents is called the **decimal point**. *8 dollars 4 cents* may be written \$8.04. A zero is written directly after the decimal point if the number of cents is less than ten.

UNITED STATES MONEY

1. Supply the missing numbers: A nickel = . . . cents; a dime = . . . cents; a quarter dollar = . . . cents; a half dollar = . . . cents; a dollar = . . . cents.

2. Write, using the dollar sign; read your answers:

7 dollars	3 dollars 15 cents	1 dollar 1 cent
5 cents	8 dollars 40 cents	15 dollars 8 cents
6 cents	25 dollars 50 cents	38 dollars 80 cents

3. Read, then write from dictation, using the dollar sign:

2.75	\$8.20	\$10.10	\$15.04	\$1.08
1.88	\$9.30	\$25.15	\$17.75	\$5.05
4.15	\$6.55	\$11.11	\$20.02	\$2.02
1.52	\$7.12	\$16.44	\$45.45	\$9.13

Read these advertisements:

- “Mother Goose Nursery Rhymes, \$1.19; cloth binding, 35c. Peter Rabbit Series, 29c. Mother Fairy Tales, 48c.”
- “Girls’ \$4.50 to \$8 coats on sale at 11 A.M., \$1.79 to \$3.79.”

Add. Remember that the decimal point is placed before the last two figures in the answer. Check results.

6.	7.	8.	9.	10.
\$7.45	\$6.82	\$0.14	\$9.25	\$8.
4.84	4.02	1.23	4.28	0.9
5.75	3.27	7.54	5.16	3.5
7.12	5.63	9.38	4.55	9.2
1.14	2.18	8.62	6.09	4.2
2.16	9.36	3.27	7.22	6.0
3.21	8.72	5.76	3.16	7.5
4.76	1.10	0.82	4.22	8.2
<u>8.32</u>	<u>4.06</u>	<u>4.25</u>	<u>5.04</u>	<u>9.9</u>

PROBLEMS IN ADDITION

1. One day Sam said: "Only 14 more days of vacation; 6 days of vacation have passed." How long was Sam's vacation?

2. Mary, Janet, and Josephine spent part of their vacation together: 24 days at Mary's house, 21 days at Janet's, and 18 days at Josephine's. How many days were the girls together during their vacation?

3. Maud's mother bought a dozen ears of sweet corn for 30 cents, a quart of blackberries for 20 cents, and a box of tomatoes for 15 cents. How much did she pay for all?

4. A hailstorm broke 5 panes of glass in one window of Fred's home, 4 in each of two others, 2 in another, and 1 in another. How many panes were broken in the 5 windows?

5. In Nell's town one day each year is Tag Day, a day on which money is collected for the hospital. Nell sold 32 tags on Tag Day, Anna sold 48, and Rose sold 65. How many did the three girls sell?

6. Count 2, 5, 7, 10, 12, 15, and so on to 100. Can you do this in less than half a minute?

7. Don is 11 years old. His father said to him: "Don, I am 37 years older than you, and your mother is 33 years older than you." How old were Don's parents at that time?

8. Robert sells papers. One week he sold 364 papers and had 16 left unsold. How many did he buy that week?

9. Here are the expenses of running for one year a fifth-grade room in the school which Beatrice attends; find the total expenses:

Teacher's salary	\$1200.00
Share of cost of upkeep of building	90.75
Textbooks	192.84
School supplies, other than textbooks	113.23
All other expenses	312.67
Total	

10. Mary is ten years old. Here is what she spent in two days: ice cream cones, 14¢; balloon, 10¢; candy, 20¢; ice cream soda, 12¢. How much did she spend in the two days? Was Mary spending too much in this way? Name two good ways in which a girl of Mary's age may spend money.

11. In a fly-swatting contest Will killed 65 flies; George, 78; Frank, 92; and John, 89. How many did they all kill?

12. Paul lives in a town of about 10,000 people. He knows eight persons in his town who are each over 87 years old. Three of them are each 88, two of them are 89, one is 96, one is 98, and one is 104. What is the sum of their ages? How many persons do you know who are as old as any of these?

13. Edward's father sets aside for savings \$4.00 of each week's wages, and then usually spends the remainder of his weekly wages thus: food, \$14; rent, \$5.60; clothing, \$4.55; heat and light, \$1.40; other expenses, \$5.45. What are his wages per week?

14. In an election for president of their class, Hugh received 42 votes, Arthur received 12 more votes than Hugh, and William 10 more than Arthur. How many votes did the three together receive?

15. As an aid to saving, Rebecca's mother has envelopes on which are written *Telephone, Milk, Rent*, and so on, and the amount of money to be inserted at the close of each week to provide through the year for the family. How much does she place in all the envelopes each week, the envelopes being marked as follows: Telephone, \$0.75; Milk, \$1.30; Rent, \$4.00; Insurance, \$1.00; Coal, \$2.00; Electricity, \$1.00; Clothes, doctor, pleasure, \$2.00; Commutation, \$1.50; Groceries and other supplies, \$14.00?

16. Find the cost of this summer outfit which a Boy Scout bought:

Hat	\$.75
Cotton shirt	1.75
Cotton shorts	1.50
Cotton stockings	.80
Neckerchief	.50
Lanyard	.15
Knife	.50
Blanket	4.50
Belt	.75
Total	

17. The students of the domestic science classes of the Holmes Junior High School cook and serve noonday lunches. Here is a sample of the daily menu. Find the cost:

Three fried oysters	\$1.12
Potato salad	.06
Two biscuits	.04
Butter	.01
Fruit cup	.08
Coffee or cocoa	.05
Total	

Subtraction. Taking one number from another is called *subtraction*. The number thus obtained is called the *difference* or the *remainder*. The number from which we subtract is called the *minuend*; the number we subtract is called the *subtrahend*.

NOTE. Subtraction is sometimes defined as the process of finding the number, which, when added to one of two numbers, makes the other. This method usually employed in *making change* is based on this definition.

ACCURACY AND SPEED TEST

1. What is the best record which you can make in naming these differences at sight?

8	5	12	1	9	15	11	13	14	12
<u>4</u>	<u>2</u>	<u>5</u>	<u>1</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>6</u>	<u>9</u>	<u>7</u>

4	6	14	13	12	11	4	9	5	3
<u>3</u>	<u>2</u>	<u>5</u>	<u>9</u>	<u>8</u>	<u>6</u>	<u>4</u>	<u>5</u>	<u>1</u>	<u>2</u>

9	11	9	7	12	9	13	7	11	16
<u>2</u>	<u>7</u>	<u>9</u>	<u>2</u>	<u>4</u>	<u>4</u>	<u>8</u>	<u>4</u>	<u>3</u>	<u>7</u>

0	3	6	10	8	6	8	2	12	8
<u>4</u>	<u>1</u>	<u>6</u>	<u>7</u>	<u>2</u>	<u>5</u>	<u>1</u>	<u>2</u>	<u>9</u>	<u>5</u>

9	10	14	15	13	10	10	7	8	6
<u>1</u>	<u>2</u>	<u>7</u>	<u>8</u>	<u>4</u>	<u>8</u>	<u>5</u>	<u>7</u>	<u>7</u>	<u>1</u>

5	8	10	11	10	5	9	5	12	13
<u>3</u>	<u>8</u>	<u>6</u>	<u>2</u>	<u>9</u>	<u>4</u>	<u>3</u>	<u>5</u>	<u>3</u>	<u>7</u>

3	6	8	10	9	3	11	6	2	7
<u>5</u>	<u>3</u>	<u>6</u>	<u>1</u>	<u>7</u>	<u>3</u>	<u>5</u>	<u>4</u>	<u>1</u>	<u>3</u>

4	4	15	14	11	15	16	7	9	7
<u>2</u>	<u>1</u>	<u>9</u>	<u>8</u>	<u>9</u>	<u>6</u>	<u>8</u>	<u>6</u>	<u>8</u>	<u>1</u>

8	7	14	16	11	12	18	17	10	17
<u>3</u>	<u>5</u>	<u>6</u>	<u>9</u>	<u>4</u>	<u>6</u>	<u>9</u>	<u>8</u>	<u>3</u>	<u>9</u>

2. Count by 2's from 50 to 0; from 51 to 1.

3. Count by 3's from 30 to 0; from 31 to 1; from 32 to 2.

4. Count by 4's from 40 to 0; from 41 to 1; from 42 to 2 from 43 to 3.

5. Count by 5's from 50 to 0; from 51 to 1; from 52 to 2 from 53 to 3; from 54 to 4.

ACCURACY AND SPEED TEST

1. You should be able to subtract at sight any number of one figure from any number of two figures; for example:

4	38	Subtract 4 from each number in the right-hand column, saying answers only. Thus, 34, 74, 14, and so on. Then subtract 3 from each number in the right-hand column, and so on until you have subtracted each number in the column to the left from each number in the column to the right.
3	78	
2	18	
1	28	
6 from	48	
8	68	

5	88	2. Change the last figure in each number in the right-hand column to 9, and subtract as before then to 7 and subtract, and so on until you have subtracted any number of one figure from any number of two figures.
7	98	
9	58	

You should also be able to subtract at sight a number of two figures from a number of two figures.

Subtract at sight; name differences only:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
3.	30	50	70	80	90	90	80	90
	<u>20</u>	<u>30</u>	<u>40</u>	<u>50</u>	<u>40</u>	<u>60</u>	<u>30</u>	<u>20</u>
4.	14	36	48	55	72	75	86	90
	<u>10</u>	<u>20</u>	<u>30</u>	<u>30</u>	<u>40</u>	<u>50</u>	<u>50</u>	<u>60</u>
5.	26	45	56	55	28	37	56	70
	<u>16</u>	<u>25</u>	<u>16</u>	<u>35</u>	<u>12</u>	<u>25</u>	<u>44</u>	<u>60</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
6.	32	31	42	45	56	62	75	75
	<u>17</u>	<u>19</u>	<u>14</u>	<u>27</u>	<u>38</u>	<u>39</u>	<u>48</u>	<u>46</u>

SUGGESTION. In example 6, *a*, think : 32, 22, 15.

7. Make another set of examples like each of the sets in examples 3 to 6 and subtract at sight.

Making Change. In making change for 50¢ given in payment for a 20-cent ball, the merchant, using the least number of pieces of money possible, counts out the change thus: 20, 25, 50, at the same time giving the customer a 5-cent piece and a quarter dollar.

In making change it is customary to add to the amount of the sales enough change to make the sum of the sales and the change equal the money given in payment.

TO THE TEACHER. Real money should be used if it is convenient.

MAKING CHANGE

Count aloud the right change in each of these purchases, using as few pieces of money as possible, and state how much change is given (1) when the money paid is the amount stated in the third column; (2) when it is the amount stated in the fourth column.

	<i>Purchases</i>	<i>Cost</i>	<i>Money Paid</i>	<i>Money Paid</i>
1.	Apron	80¢	dollar	\$2-bill
2.	Writing paper	59¢	75¢	60¢
3.	Scout compass	\$1.75	\$2-bill	\$5-bill
4.	Gift book	88¢	dollar	\$2-bill
5.	Lunch paper	5¢	quarter dollar	half dollar
6.	Scrapbook	\$1.10	\$2-bill	\$1.50
7.	Car tickets	30¢	half dollar	dollar

<i>Purchases</i>	<i>Cost</i>	<i>Money Paid</i>	<i>Money Paid</i>
8. Hair ribbon	55¢	dollar	\$2-bill
9. Football	\$2.10	\$3	\$5-bill
10. Running shoes	\$2.45	\$3	\$5-bill
11. Tennis net	\$3.25	\$5-bill	\$10-bill
12. Tennis racket	\$3.15	\$5-bill	\$10-bill

13. Bring to class three examples like those of this exercise telling of purchases you have made, the money you paid, and the change given you.

How to Subtract Large Numbers. Subtract 389 from 951.

$$\begin{array}{r} 951 \text{ Minuend} \\ 389 \text{ Subtrahend} \\ \hline 562 \text{ Difference} \end{array}$$

$$\begin{array}{r} \text{Check: } 389 \\ \quad 562 \\ \hline \quad 951 \end{array}$$

$$\begin{array}{l} (1) \text{ Think:} \\ 11 - 9 = 2. \text{ Write 2.} \\ 14 - 8 = 6. \text{ Write 6.} \\ 8 - 3 = 5. \text{ Write 5.} \end{array}$$

$$\begin{array}{l} \text{Or, (2) Think:} \\ 11 - 9 = 2. \text{ Write 2.} \\ 15 - 9 = 6. \text{ Write 6.} \\ 9 - 4 = 5. \text{ Write 5.} \end{array}$$

REMARK. In (1) 951 is thought of as 8 hundreds + 14 tens + 11 units.

In (2) the minuend is increased by 10 and the subtrahend by 1 ten; again the minuend is increased by 10 tens and the subtrahend by 1 hundred. Equal increasing the minuend and subtrahend does not change the difference.

TO THE TEACHER. In written subtraction teach one method only.

To check the result in subtraction see that the sum of the difference and the subtrahend is equal to the minuend.

SUBTRACTION

Subtract and check:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	798	978	481	750	822	70
	<u>243</u>	<u>345</u>	<u>326</u>	<u>223</u>	<u>289</u>	<u>27</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
2.	5391 <u>2284</u>	7632 <u>4486</u>	8201 <u>4179</u>	9112 <u>8149</u>	9102 <u>7198</u>	6214 <u>3817</u>
3.	7001 <u>4182</u>	8002 <u>3192</u>	7000 <u>2467</u>	9000 <u>2001</u>	8000 <u>3011</u>	8002 <u>2107</u>

Copy and subtract. In copying, and in writing your answer, be sure to write the decimal points in a column.

- | | | |
|--------------------|---------------------|---------------------|
| 4. \$4.75 - \$2.25 | 5. \$17.60 - \$2.50 | 6. \$48.05 - \$9.75 |
| 7. \$7.00 - \$2.75 | 8. \$25.40 - \$7.75 | 9. \$50.00 - \$9.38 |

ACCURACY AND SPEED TEST

In an example in written subtraction there are as many separate subtractions to make as there are figures in the subtrahend. These subtractions consist in taking a number of one figure from a number of one figure, or a number of one figure from a number of two figures. The difference in each case is a number of one figure or zero. All such subtractions possible are included in the following 12 examples. Find the answers to as many of these 12 examples as possible in 4 minutes; then check results. Do not copy the examples. Drill frequently.

1.	2.	3.	4.
861758930	626250541	102406732	527067253
<u>488272680</u>	<u>485707280</u>	<u>65392891</u>	<u>365861290</u>
5.	6.	7.	8.
116813118	10378345	278754376	174073189
<u>43292635</u>	<u>7483071</u>	<u>179746510</u>	<u>92549775</u>
9.	10.	11.	12.
1015083799	138599094	172909159	149644097
<u>251304589</u>	<u>73610189</u>	<u>93421630</u>	<u>64051436</u>

PROBLEMS IN SUBTRACTION

1. Helen sent out 30 invitations to her birthday party. All the guests invited came but 8. How many came?
2. Charles is saving to buy a pony. He saved \$32 during the summer. How much more does he need to save if the pony cost \$60?
3. How much change should your father receive from a \$20-bill given in payment for your suit of clothes which cost \$16?
4. One week James bought 200 newspapers. On Monday, Thursday, and Saturday he had none remaining unsold; on Tuesday he had 6; on Wednesday, 7; and on Friday, 12. How many did he sell that week?
5. Sarah paid 23¢ for a quart bottle of milk and received 5¢ when she returned the empty bottle. How much did she pay for the milk?
6. Fred and James attended a county fair. They each had a dollar when they left home. Fred spent all of his dollar but 25¢ and James all of his but 12¢. How much did each spend? How much did both spend? James spent how much more than Fred?
7. Norman sells papers. Find from this record of his for two weeks how many papers he sold each day during the first week and each day during the second week. Fill in the totals:

	FIRST WEEK		SECOND WEEK	
	<i>Bought</i>	<i>Unsold</i>	<i>Bought</i>	<i>Unsold</i>
<i>Mon.</i>	60	9	75	4
<i>Tues.</i>	60	0	75	9
<i>Wed.</i>	75	6	80	11
<i>Thur.</i>	75	4	80	2
<i>Fri.</i>	75	0	80	7
<i>Sat.</i>	120	14	130	15
<i>Total</i>				

8. Here are the scores made in six games played on the home floor of the Star basketball team; also the scores made in six games played on the home floor of the Mohicans. How many more points did the Stars make than the visiting teams in the six games? How many more points did the Mohicans make than the visiting teams?

	<i>Stars</i>	<i>Visiting Team</i>	<i>Mohicans</i>	<i>Visiting Team</i>
<i>1st Game</i>	26	6	10	15
<i>2d Game</i>	13	14	19	7
<i>3d Game</i>	5	2	7	4
<i>4th Game</i>	19	10	12	17
<i>5th Game</i>	22	30	25	11
<i>6th Game</i>	<u>36</u>	<u>15</u>	<u>19</u>	<u>6</u>
<i>Total</i>				

Cash Accounts. Pupils should early form the habit of keeping weekly or monthly cash accounts.

BOY'S ACCOUNT FOR WEEK ENDING SEPTEMBER 10, 1921

1921		RECEIPTS			1921		EXPENSES		
Sept.	6	Cash on hand	1	25	Sept.	6	Car tickets		30
	6	Waste paper		40		8	2 Thrift stamps		50
	7	Allowance		75		8	Ball game		15
	9	Picking fruit	1	00		10	School bag	1	15
	10	Washing car		50		10	<i>Balance</i>	1	80
			3	90				3	90
Sept.	11	Cash on hand	1	80					

How much were this boy's receipts for the week? How much did he spend? How was *Balance* on the right side of the account found? How much cash had he on hand at the close of the week?

Balancing an Account. Finding the difference between the receipts and the expenses is called *balancing* the account. The sum found on the left side equals that on the right side, which checks the work.

CASH ACCOUNTS

Make out and balance the following accounts:

1. Receipts: Oct. 1, cash on hand, \$1.75; Oct. 7, allowance, \$0.50; Oct. 4, from brother, \$0.25; Oct. 6, doll's sweater, \$0.25.

Expenses: Oct. 2, Junior Red Cross, \$0.25; Oct. 3, thrift stamp, \$0.25; Oct. 5, gift for mother, \$0.25; Oct. 6, candy, \$0.10.

2. Receipts: Nov. 1, cash on hand, \$2.10; Nov. 1, allowance, \$0.50; delivering papers, \$0.25; Nov. 5, sale of magazines, \$0.90.

Expenses: Nov. 2, football game, \$0.25; Nov. 3, thrift stamp, \$0.25; Nov. 3, magazines, \$0.60; Nov. 6, picture show, \$0.15.

Multiplication. Instead of writing $7+7+7=21$, we may write $3\times 7=21$. Instead of writing $\$7+\$7+\$7=\21 , we may write $3\times \$7=\21 . In the expression $3\times 7=21$, which number is the **multiplier**? Which is the **multiplicand**? Which is the **product**?

Nature of Multiplicand, Multiplier, and Product. In the expression $3\times \$7=\21 , name the multiplier; the multiplicand; the product. Observe that if the multiplicand is an *amount*, the product is a *like amount*; for example, $3\times 2\text{¢}=6\text{¢}$. The multiplier is never an amount; it is always a *number*; as, 2 or 5 or 9.

Sign of Multiplication. The sign of multiplication is $\times$. Read *times* when the multiplier is written before it, and *multiplied by* when the multiplier is written after it.

Thus, $3\times 5\text{¢}$ is read 3 *times* 5¢.

$5\text{¢}\times 3$ is read 5¢ *multiplied by* 3.

Read and state products:

$3\times \$2$	$4\times 5\text{ yd.}$	$6\times 5\text{ rd.}$	$3\times 4\text{ qt.}$
$2\text{¢}\times 9$	$9\text{ pt.}\times 3$	$7\times 6\text{ balls}$	$8\text{ in.}\times 4$

ACCURACY AND SPEED TEST

Practice on the drills below until you can name all the results for each drill in 45 seconds. This practice is necessary to make you skillful in multiplication.

DRILL 1

2	3	1	2	3	6	1	2	8	3	4	6	1	5	2
4	7	6	5	8	7	9	6	7	9	5	6	1	7	8
4	3	5	7	1	2	1	9	3	4	6	2	2	1	3
9	3	6	7	2	7	5	9	5	7	8	2	3	8	6
9	3	1	4	6	5	1	8	2	4	5	1	8	5	4
7	4	7	8	9	8	3	8	9	6	5	4	9	9	4

DRILL 2

5	9	2	7	6	8	3	8	5	7	9	4	7	9	3
3	2	1	4	5	1	3	6	5	2	3	4	1	5	2
6	5	7	1	7	8	9	4	6	8	6	8	6	3	5
4	4	6	1	5	8	6	1	3	5	2	3	6	1	2
6	4	7	7	9	9	5	2	4	8	9	8	8	8	9
4	2	3	7	8	7	1	2	3	2	1	4	7	4	

DRILL 3

Here are 24 of the hardest combinations of the multiplication tables. Name the products. Time yourself. Drill on them daily.

1×11	8×6	12×4	9×9	7×6	12×5
3×8	12×10	9×7	12×12	9×4	7×7
2×11	12×7	11×10	9×6	12×8	8×4
2×9	7×4	12×6	8×7	12×3	9×8

Below are the same 24 multiplication combinations, set in reverse form when possible. Name the products at sight. Time yourself and compare your record with the record you made in naming the products in the 24 combinations given on page 23.

6×8	10×12	6×7	10×11	12×12	9×11
11×12	8×9	7×12	4×8	7×9	9×9
6×12	8×8	8×12	5×12	3×12	7×8
11×11	4×12	7×7	4×7	4×9	6×9

DRILL 4

In written multiplication we must make use not only of the multiplication products, but we must also add numbers of one figure to each of these products.

$$4 \times \begin{Bmatrix} 7 \\ 8 \\ 3 \\ 1 \\ 4 \\ 5 \\ 6 \\ 9 \\ 2 \end{Bmatrix} + \begin{Bmatrix} 5 \\ 7 \\ 1 \\ 3 \\ 2 \\ 8 \\ 6 \\ 9 \\ 4 \end{Bmatrix}$$

At sight multiply any number in the column to the left by 4 and add to the product any number in the column to the right. Change the multiplier to 5 and proceed as before; change it to 2; to 7; to 3; to 9; to 8; to 6.

To use this drill effectively, place the chart, shown above, on the blackboard and as some one points to two numbers in it, any one in the column to the left and any one in the column to the right, say the result as required. Thus, if the numbers selected are 7 and 5, say 33; if the numbers selected are 9 and 3, say 44.

MULTIPLICATION

Read the following; name the multiplicand, the multiplier and give at sight the product:

- $5 \times 6\text{¢}$
- $6 \times \$9$
- $\$12 \times 11$
- $11 \times 7 \text{ doz.}$
- $12 \text{ bu.} \times 6$
- $12 \times 10 \text{ q.}$
- $11 \times 9 \text{ gal.}$
- $8 \text{ ft.} \times 11$
- $9 \text{ in.} \times 12$

How to Multiply Large Numbers. Multiply 4756 by 8.

4756	<i>Multiplicand</i>	<i>In practice think: 48 (write 8); 40, 44 (write 4);</i>
8	<i>Multiplier</i>	56, 60 (write 0); 32, 38 (write 38).
38048	<i>Product</i>	

To check multiplication, go over the work a second time and see if your results agree.

MULTIPLYING LARGE NUMBERS

Multiply; check each product:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	2578	4986	4073	5869	2597	3468
	<u>2</u>	<u>2</u>	<u>3</u>	<u>3</u>	<u>4</u>	<u>4</u>
2.	2795	8603	9214	8376	7348	2659
	<u>5</u>	<u>5</u>	<u>6</u>	<u>6</u>	<u>7</u>	<u>7</u>

In examples 3 and 4, remember to place the decimal point before the last two figures of the product.

3.	\$37.46	\$23.78	\$54.92	\$71.09	\$17.10	\$49.38
	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
4.	\$70.94	\$68.07	\$37.89	\$45.62	\$73.59	\$62.84
	<u>8</u>	<u>9</u>	<u>8</u>	<u>8</u>	<u>9</u>	<u>9</u>

5. Make and work 2 examples like example 1; like example 2; like example 3; like example 4.

Multiplying by 10.

$$10 \times 32 = ?$$

$$10 \times 2 \text{ units} = 20 \text{ units, or 2 tens.}$$

$$10 \times 3 \text{ tens} = 30 \text{ tens, or 3 hundreds.}$$

$$\text{The product is 3 hundreds} + 2 \text{ tens} = 320.$$

Annexing one zero to a whole number multiplies the number by 10.

Name at sight the products: 10×9 ; 10×25 ; 10×36 ; 10×48 .

Multiplying by 100 and by 1000.

$$100 \times 32 = ?$$

$$\begin{aligned} 100 \times 32 &= 10 \times 10 \times 32 \\ &= 10 \times 320 \\ &= 3200 \end{aligned}$$

$$1000 \times 32 = ?$$

$$\begin{aligned} 1000 \times 32 &= 10 \times 100 \times 32 \\ &= 10 \times 3200 \\ &= 32000 \end{aligned}$$

Annexing two zeros to a whole number multiplies it by 100 annexing three zeros multiplies it by 1000.

Name at sight the products: 100×7 ; 100×9 ; 100×35 ; 100×75 ; 100×92 ; 100×95 ; 1000×85 ; 1000×112 .

SPECIAL MULTIPLIERS

1. Name at sight the products: 10×45 ; 100×96 ; 100×50 ; 1000×6 ; 1000×8 ; 1000×9 ; 1000×10 .

$$2. \quad 40 \times 9 = ?$$

$$\begin{aligned} 40 \times 9 &= 10 \times 4 \times 9 \\ &= 10 \times 36 \\ &= 360 \end{aligned}$$

$$3. \quad 400 \times 8 = ?$$

$$\begin{aligned} 400 \times 8 &= 100 \times 4 \times 8 \\ &= 100 \times 32 \\ &= 3200 \end{aligned}$$

In practice multiply by 4 and annex a zero.

In practice multiply by 4 and annex two zeros.

4. Name at sight the products:

8	9	7	8	9	9	7	8
<u>40</u>	<u>30</u>	<u>50</u>	<u>70</u>	<u>600</u>	<u>700</u>	<u>900</u>	<u>900</u>

$$5. \quad 27 \times \$3 = ?$$

$$27 \times \$1 = \$27$$

$$27 \times \$3 = 3 \times \$27, \text{ or } \$81$$

In practice multiply by the less number

6. James sold 35 bunches of radishes at 5¢ a bunch. How much did he receive for them? For 25 bunches?

7. At the end of July John's father was paid for 26 days' work at \$4 a day. How much was he paid?

8. Grace's sister paid \$6 a week for lodging for 15 weeks. How much did she pay?

9. Sam's father sold from his garden 480 pounds of cabbage at 8¢ a pound. How much did he receive for it?

10. Name at sight the products:

7	5	8	7	6	9	8	9
<u>6000</u>	<u>8000</u>	<u>4000</u>	<u>5000</u>	<u>7000</u>	<u>6000</u>	<u>9000</u>	<u>8000</u>

How to Multiply by Large Numbers. Multiply 576 by 428.

This shows the complete work:

In practice write only this:

	576		576
	428		428
8×576 =	<u>4608</u>		<u>4608</u>
20×576 =	11520	(see page 26, example 2)	1152
400×576 =	230400	(see page 26, example 3)	2304
428×576 =	<u>246528</u>		<u>246528</u>

Special Forms.

<i>a</i>	<i>b</i>	<i>c</i>
7632	3863	4800
<u>502</u>	<u>2006</u>	<u>230</u>
15264	23178	144
38160	7726	96
<u>3831264</u>	<u>7749178</u>	<u>1104000</u>

Find the following indicated products:

6875×208	7432×3008	9875×479
7934×2080	2457×4028	4080×6008
7008×9081	8307×2093	5700×7009

ACCURACY AND SPEED TEST

Work as many of these examples in multiplication as you can in 6 minutes. Then check your work by going over it a second time. Practice to better your record.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1. 4268 <u>27</u>	3579 <u>53</u>	7649 <u>29</u>	9764 <u>64</u>
2. 2853 <u>780</u>	7395 <u>35</u>	4769 <u>87</u>	5832 <u>30</u>
3. 8642 <u>86</u>	7395 <u>904</u>	2486 <u>49</u>	5972 <u>72</u>
4. 6974 <u>63</u>	9753 <u>68</u>	8523 <u>92</u>	2354 <u>4</u>

Multiply the numbers to the left of the line by each number to the right of the line:

5. 2843		<i>a</i> 298	10. 9542		<i>a</i> 408
6. 5762		<i>b</i> 703	11. 6748		<i>b</i> 3069
7. 7934		<i>c</i> 485	12. 6854		<i>c</i> 2006
8. 6797		<i>d</i> 801	13. 8319		<i>d</i> 5007
9. 8521		<i>e</i> 907	14. 8532		<i>e</i> 6009

PROBLEMS IN MULTIPLICATION

Before working a problem it is usually well to estimate what the answer should be; then after working the problem compare the answer with your estimate.

1. How much does Dorothy spend in a week for ice cream cones if she buys a 6¢ cone each day?

2. Mr. Hooper bought 10 tons of coal at \$14 a ton. Find the cost. What was the cost of 5 tons?

3. How much does Jane save in a year by buying a thrift stamp each month?
4. There are 60 minutes in an hour and 24 hours in a day. How many minutes are there in a day?
5. What reduction was made on 3 pairs of children's 50¢ socks bought at 39¢ a pair?
6. Mrs. Leeds buys 3 quarts of milk daily at \$0.14 a quart. What is her milk bill for a week?
7. James sold 15 bunches of onions from his home garden, bunches at 6¢ a bunch and the remainder at 5¢ a bunch. How much did he receive for them?
8. How much does Mrs. Hill save by buying 6 bushels of potatoes at \$2.40 a bushel, instead of buying them by the peck at \$0.75 a peck? (1 bushel = 4 pecks)
9. How many pounds are there in 36 bales of cotton, each weighing 500 pounds?
10. Complete and learn: $1 \times 1 = 1$, $2 \times 2 = 4$, $3 \times 3 = 9$, and so on, to $25 \times 25 = 625$.
11. A banker showed John a bundle made up of four packages of \$5-bills. Each package contained fifty \$5-bills. How much money did the bundle contain?
12. If I buy 8 pounds of sugar at 9¢ a pound, and 2 pounds of sirloin steak at 45¢ a pound, how much change should I receive from a \$10-bill given in payment for them?
13. How much did a dealer receive for 36 crates of eggs, each crate containing 36 dozen, if he sold the eggs at \$0.60 a dozen?
14. John's father works for a farmer. He receives \$60 a month for 9 months of the year and \$50 a month for the 3 remaining months. He also receives free house rent worth \$240. What are his yearly wages?

Factors. The *factors* of a number are such numbers as multiplied together will produce the number.

Thus, the factors of 30 are 2, 3, and 5.

Division. In multiplication we are given two factors and are required to find the product. If we are given the product of two factors and one of them, the operation of finding the other factor is called *division*.

For example, in $2 \times \$3 = \6 , we have given the factors 2 and \$3 and are required to find the product \$6; but in division we have given the product and either the factor 2 or the factor \$3 and are required to find the other factor.

Ways of Expressing Division. We may write 6 divided by 2 in any of these ways:

$$6 \div 2 = 3 \quad \text{or} \quad \begin{array}{r} 2 \overline{)6} \\ 3 \end{array} \quad \text{or} \quad \frac{6}{2} = 3$$

Dividend, Divisor, and Quotient. In $6 \div 2 = 3$, the number *divided*, that is, 6, is called the *dividend*; the number by which we divide, that is, 2, is called the *divisor*; the number found by division, that is, 3, is called the *quotient*.

Nature of the Quotient. Since either of the two factors of a product may be used as the divisor, care must be exercised in writing the quotient when the dividend is an *amount*. Thus, since $2 \times \$3 = \6 , we may have either:

$$(1) \begin{array}{r} 2 \overline{)\$6} \\ \$3 \end{array} \quad \text{or} \quad (2) \begin{array}{r} \$3 \overline{)\$6} \\ 2 \end{array}$$

In (1) we have found *one half* of \$6, the quotient \$3 being an *amount* like the dividend. In (2) we have found how many times \$6 contains \$3, the quotient 2 being a *number* only.

Remainder. In dividing 37 by 4 we get as a quotient 9 with a part of the dividend, 1, left over undivided. It often happens as in this case, that a divisor does not exactly divide the dividend. That part of the dividend which is left is called the *remainder*.

If the division in the above example were complete, the quotient would be $9\frac{1}{4}$ with no remainder.

ACCURACY AND SPEED TEST

Try to name the quotients in these 72 examples in not more than 60 seconds. Read from left to right, then down the columns.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
1.	3) <u>9</u>	4) <u>8</u>	8) <u>16</u>	5) <u>15</u>	4) <u>20</u>	5) <u>40</u>	6) <u>54</u>	7) <u>21</u>
2.	3) <u>18</u>	4) <u>36</u>	7) <u>35</u>	7) <u>7</u>	5) <u>25</u>	9) <u>36</u>	2) <u>10</u>	7) <u>42</u>
3.	3) <u>12</u>	8) <u>40</u>	9) <u>9</u>	8) <u>24</u>	5) <u>45</u>	7) <u>14</u>	6) <u>48</u>	5) <u>20</u>
4.	4) <u>32</u>	6) <u>6</u>	9) <u>18</u>	6) <u>30</u>	7) <u>63</u>	3) <u>27</u>	2) <u>8</u>	8) <u>48</u>
5.	8) <u>32</u>	4) <u>24</u>	5) <u>35</u>	3) <u>24</u>	5) <u>5</u>	6) <u>36</u>	6) <u>18</u>	7) <u>28</u>
6.	7) <u>49</u>	5) <u>10</u>	8) <u>64</u>	4) <u>4</u>	9) <u>45</u>	7) <u>56</u>	2) <u>16</u>	9) <u>27</u>
7.	9) <u>63</u>	4) <u>16</u>	2) <u>2</u>	3) <u>21</u>	3) <u>6</u>	6) <u>24</u>	9) <u>72</u>	4) <u>28</u>
8.	4) <u>12</u>	3) <u>3</u>	8) <u>72</u>	2) <u>6</u>	9) <u>54</u>	5) <u>30</u>	2) <u>12</u>	3) <u>15</u>
9.	2) <u>18</u>	8) <u>8</u>	9) <u>81</u>	6) <u>12</u>	2) <u>4</u>	6) <u>42</u>	2) <u>14</u>	8) <u>56</u>

Read carefully what is said about the nature of the quotient, page 30; then name the quotients in examples 10, 11, and 12.

10.	2¢) <u>6¢</u>	5) <u>\$10</u>	\$5) <u>\$10</u>	2) <u>12 in.</u>	2¢) <u>8¢</u>	4) <u>8 gal.</u>
11.	2) <u>8 pk.</u>	4 in.) <u>8 in.</u>	3) <u>9 yd.</u>	5) <u>20 bu.</u>	3 yd.) <u>9 yd.</u>	5) <u>15¢</u>
12.	2) <u>10¢</u>	2 in.) <u>12 in.</u>	4 pt.) <u>12 pt.</u>	4 gal.) <u>8 gal.</u>		

DRILL FOR SHORT DIVISION

You cannot become skillful in short division unless you can decide quickly what is the correct quotient and remainder (if any) in each division as you proceed in working an example. Review the following exercise until you can use this chart without making a mistake.

Reading down the columns and naming quotients and remainders, divide as follows:

1. Begin at 2 and divide the numbers in *A* and *B* by 2, saying only quotients or quotients and remainders.

Thus for *A* say 1; 1, remainder 1; 2; 2, remainder 1; and so on to 4, remainder 1. Then for *B* say 7; 8, remainder 1; and so on to 9, remainder 1.

2. Begin at 3 and divide the numbers in *A*, *B*, and *C* by 3.

3. Begin at 4 and divide the numbers in *A*, *B*, *C*, and *D* by 4.

4. Begin at 5 and divide the numbers in *A*, *B*, *C*, *D*, and *E* by 5.

Beginning at 6, 7, 8, and 9 continue in this way until you have used 6, 7, 8, and 9 as divisors. When you have completed these divisions, you will have used *all divisors from 2 to 9 inclusive with every dividend possible to obtain quotients which are numbers one figure each, with or without a remainder.*

DRILL CHART FOR SHORT DIVISION

	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>
	14	29	36	40	53	64	79	81
<i>A</i>	17	22	32	47	58	60	75	82
2	10	24	30	43	51	69	72	87
3	15	26	37	45	57	65	78	84
4	16	27	34	49	50	63	74	86
5	11	23	39	42	54	68	71	88
6	13	20	33	48	59	61	76	83
7	18	25	38	44	56	66	73	85
8	12	28	31	41	52	62	77	89
9	19	21	35	46	55	67	70	80

How to Divide — Short Division. Divide 5094 by 6.

$$\begin{array}{r} 6 \overline{)5094} \\ 849 \end{array}$$

In practice think: $50 \div 6$ (write 8)

$29 \div 6$ (write 4)

$54 \div 6$ (write 9)

Name the quotient.

Check

849

$$\begin{array}{r} 6 \\ \underline{5094} \end{array}$$

To check the result in division, find the product of the divisor and quotient and to it add the remainder (if any); the result should be the dividend.

SHORT DIVISION

Divide and check:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1. $2)\underline{12570}$	$3)\underline{8595}$	$4)\underline{15136}$	$5)\underline{31240}$
2. $4)\underline{18512}$	$6)\underline{55578}$	$2)\underline{15886}$	$3)\underline{11382}$
3. $5)\underline{39765}$	$6)\underline{32868}$	$7)\underline{25403}$	$7)\underline{33999}$
4. $8)\underline{19168}$	$9)\underline{35055}$	$8)\underline{43896}$	$9)\underline{66834}$
5. $4)\underline{\$57.00}$	$5)\underline{\$103.75}$	$6)\underline{\$518.40}$	$7)\underline{\$667.66}$

In example 5 remember to place the decimal point before the last two figures in the quotient.

Special Divisors. $60 \div 10 = 6$, for $10 \times 6 = 60$.

$600 \div 100 = 6$, for $100 \times 6 = 600$.

$6000 \div 1000 = 6$, for $1000 \times 6 = 6000$.

Cutting off one zero from the right of a whole number divides it by 10; cutting off two zeros divides it by 100; cutting off three zeros divides it by 1000.

SPECIAL DIVISORS

Name at sight the quotient:

1. $210 \div 10$; $320 \div 10$; $480 \div 10$; $750 \div 10$; $890 \div 10$.

2. $100)\underline{2500}$ $100)\underline{3600}$ $100)\underline{4200}$ $100)\underline{7500}$

3. Divide the following numbers by 1000: 4000; 9000; 9000; 75000.

How to Divide — Long Division. In the previous grade you learned that the difficulties in long division are *estimating the right quotient figure* and deciding *what is the next thing to do*. Study these three solutions carefully.

1. Divide 1472 by 31.

SOLUTION

47	
31)1472	147 ÷ 31 is about 140 ÷ 30, or 14 ÷ 3.
124	Estimate 14 ÷ 3 = 4. Write 4 over tens.
232	Multiply, subtract, bring down.
217	232 ÷ 31 is about 230 ÷ 30, or 23 ÷ 3.
15	Estimate 23 ÷ 3 = 7. Write 7 over units.
	Multiply and subtract.

Check: $31 \times 47 + 15 = 1472$.

2. Divide 4133 by 49.

SOLUTION

84	
49)4133	413 ÷ 49 is about 410 ÷ 50, or 41 ÷ 5.
392	Estimate 41 ÷ 5 = 8. Write 8 over tens.
213	Multiply, subtract, bring down.
196	213 ÷ 49 is about 210 ÷ 50, or 21 ÷ 5.
17	Estimate 21 ÷ 5 = 4. Write 4 over units.
	Multiply and subtract.

Check: $49 \times 84 + 17 = 4133$.

3. Divide 1663 by 36.

SOLUTION

46	
36)1663	The estimate $16 \div 3 = 5$ is too high, since 5×36 , or 180
144	greater than 166. Change the estimate to 4, which is correct
223	Multiply, subtract, bring down.
216	The estimate $22 \div 3 = 7$ is too high, since 7×36 , or 252
7	greater than 223. Change the estimate to 6, which is correct
	Multiply and subtract.

Check: $36 \times 46 + 7 = 1663$.

LONG DIVISION

Estimate and name the quotient figures in examples 1-3; then test your estimates by performing the division:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1.	$32 \overline{)64}$	$41 \overline{)82}$	$21 \overline{)65}$	$32 \overline{)129}$	$41 \overline{)207}$	$51 \overline{)359}$
2.	$19 \overline{)61}$	$29 \overline{)125}$	$28 \overline{)152}$	$39 \overline{)244}$	$38 \overline{)281}$	$49 \overline{)352}$
3.	$26 \overline{)84}$	$35 \overline{)96}$	$36 \overline{)152}$	$45 \overline{)160}$	$47 \overline{)175}$	$56 \overline{)204}$

Divide and check; remember to practice what you have learned about estimating each quotient figure:

4.	$21 \overline{)966}$	$21 \overline{)813}$	$22 \overline{)956}$	$31 \overline{)998}$	$29 \overline{)696}$	$28 \overline{)900}$
5.	$23 \overline{)824}$	$25 \overline{)875}$	$25 \overline{)925}$	$34 \overline{)927}$	$35 \overline{)935}$	$36 \overline{)912}$
6.	$41 \overline{)2296}$	$52 \overline{)2775}$	$48 \overline{)4220}$	$49 \overline{)2775}$	$59 \overline{)3286}$	$46 \overline{)2422}$
7.	$71 \overline{)2256}$	$81 \overline{)2632}$	$79 \overline{)4148}$	$88 \overline{)5675}$	$84 \overline{)5689}$	$86 \overline{)6426}$

Divide and check:

8.	$28905 \div 235$	9.	$328032 \div 408$	10.	$54756 \div 234$
11.	$219750 \div 375$	12.	$15376 \div 124$	13.	$822649 \div 907$
14.	$524176 \div 724$	15.	$344088 \div 708$	16.	$373428 \div 738$
17.	$573581 \div 709$	18.	$797424 \div 888$	19.	$610948 \div 758$
20.	$998001 \div 999$	21.	$776223 \div 777$	22.	$826148 \div 857$

ACCURACY AND SPEED TEST

Work as many of the following 16 examples in division as you can in 8 minutes. Then check your work. Practice to better your record.

1. $29 \overline{)11832}$	2. $58 \overline{)40078}$	3. $46 \overline{)15686}$	4. $85 \overline{)2295}$
5. $92 \overline{)18428}$	6. $37 \overline{)17020}$	7. $73 \overline{)15987}$	8. $64 \overline{)3334}$
9. $56 \overline{)11704}$	10. $95 \overline{)55100}$	11. $83 \overline{)26511}$	12. $76 \overline{)3085}$
13. $72 \overline{)66240}$	14. $38 \overline{)30590}$	15. $57 \overline{)40641}$	16. $98 \overline{)6272}$

SPECIAL FORMS IN DIVISION

I. Divide 1746 by 200 and check.

Thus, $200 \overline{)1746}$
8, remainder 146.

Check:
 $200 \times 8 + 146 = 1746$

Divide and check as in example 1:

2. $3585 \div 200$	3. $5685 \div 300$	4. $5125 \div 400$
5. $3625 \div 400$	6. $3751 \div 500$	7. $3958 \div 600$
8. $4825 \div 600$	9. $5275 \div 700$	10. $4900 \div 800$

II. Divide 8843 by 350 and check.

Thus, $350 \overline{)8843}$
25
70
184
175
93, remainder.

Check:
 $350 \times 25 + 93 = 8843$

Divide and check as in example 11 :

12. $4526 \div 210$

13. $5665 \div 240$

14. $6578 \div 260$

15. $9649 \div 280$

16. $8528 \div 350$

17. $9647 \div 480$

18. $25675 \div 450$

19. $32486 \div 580$

20. $48756 \div 640$

PROBLEMS IN DIVISION

1. Ada is saving for 20 weeks, the same amount each week, to have \$20 saved for Christmas. How much is she saving each week? Her sister is saving for 50 weeks to save the same sum. How much is her sister saving each week?

2. Justin worked 5 hours mowing a lawn and was paid \$1.50. How much was he paid for each hour's work?

3. What is the average age of four children if two of them are each 10 years old, one of them is 9 years old, and one of them 11 years old?

REMARK. The average of two or more numbers is found by dividing their sum by the number of numbers added. Thus, the average of 6, 10, 12, and 20 is 48 divided by 4, or 12.

4. What is the average age of three men whose ages are 96 years, 84 years, and 93 years?

5. Jacob's father sold his wheat crop of 13,210 pounds. Wheat weighs 60 pounds to the bushel. How many bushels had he and how many pounds over?

6. In a town having 280 pupils the expenses of running the schools for a year were \$12,740. Find the cost per pupil.

7. Bruce was told that the cost of constructing a sewer 2300 feet long in the city in which he lives was \$14,915. He found out how much the cost was per foot. What was it?

REVIEW TESTS IN ADDITION AND SUBTRACTION

Find the answers to as many of these addition examples as possible in 5 minutes. Then check your work. Do not copy the examples.

1.	2.	3.	4.	5.	6.	7.	8.
101	492	285	584	682	587	934	842
430	358	916	192	397	479	581	953
512	706	490	963	916	938	673	238
684	910	628	810	258	839	467	795
397	685	743	291	494	965	816	471
758	924	501	356	530	253	591	987
263	371	192	402	915	151	272	470
846	835	857	675	887	692	708	148
<u>925</u>	<u>562</u>	<u>364</u>	<u>737</u>	<u>742</u>	<u>744</u>	<u>948</u>	<u>666</u>

Find the answers to as many of these subtraction examples as possible in 4 minutes. Then check your work. Do not copy the examples.

9.	10.	11.	12.
278754376	174073189	138599094	172909159
<u>179746510</u>	<u>92549775</u>	<u>73610189</u>	<u>93421630</u>
13.	14.	15.	16.
1015083799	116813118	10378345	149644097
<u>251304589</u>	<u>43292635</u>	<u>7483071</u>	<u>64051436</u>
17.	18.	19.	20.
527067253	861758930	626250541	102406732
<u>365861290</u>	<u>488272680</u>	<u>485707280</u>	<u>65392891</u>

TO THE TEACHER. Tests like these in addition and subtraction should be given at frequent intervals and records kept of the pupils' progress.

REVIEW TESTS IN MULTIPLICATION AND DIVISION

Work as many of the following 16 examples in multiplication as you can in 6 minutes. Then check your work by going over it a second time. Practice to better your record.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1. $\begin{array}{r} 9245 \\ 48 \\ \hline \end{array}$	$\begin{array}{r} 9524 \\ 57 \\ \hline \end{array}$	$\begin{array}{r} 4952 \\ 29 \\ \hline \end{array}$	$\begin{array}{r} 6539 \\ 56 \\ \hline \end{array}$
2. $\begin{array}{r} 8274 \\ 49 \\ \hline \end{array}$	$\begin{array}{r} 3687 \\ 36 \\ \hline \end{array}$	$\begin{array}{r} 7248 \\ 82 \\ \hline \end{array}$	$\begin{array}{r} 8367 \\ 84 \\ \hline \end{array}$
3. $\begin{array}{r} 5294 \\ 63 \\ \hline \end{array}$	$\begin{array}{r} 7638 \\ 92 \\ \hline \end{array}$	$\begin{array}{r} 8736 \\ 75 \\ \hline \end{array}$	$\begin{array}{r} 9635 \\ 28 \\ \hline \end{array}$
4. $\begin{array}{r} 5396 \\ 94 \\ \hline \end{array}$	$\begin{array}{r} 8472 \\ 37 \\ \hline \end{array}$	$\begin{array}{r} 7824 \\ 65 \\ \hline \end{array}$	$\begin{array}{r} 3956 \\ 73 \\ \hline \end{array}$

Work as many of the following 16 examples in division as you can in 8 minutes. Then check your work. Practice to better your record.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
5. $34 \overline{)7106}$	$28 \overline{)15960}$	$69 \overline{)62376}$	$64 \overline{)45120}$
6. $75 \overline{)69000}$	$43 \overline{)33583}$	$82 \overline{)17876}$	$96 \overline{)20832}$
7. $46 \overline{)13984}$	$39 \overline{)8502}$	$57 \overline{)48507}$	$38 \overline{)26220}$
8. $35 \overline{)15050}$	$46 \overline{)37766}$	$65 \overline{)58890}$	$73 \overline{)41610}$

REVIEW PROBLEMS

1. Bring to class to-morrow a list of five articles which you can buy at a store, the cost of all to be less than a dollar. Give the price of each and find the cost of all.

2. Count by 100's to 1000; by 1000's to 10,000; by 10,000's to 100,000.

3. Isabel has one \$2-bill, two \$1-bills, four nickels, two dimes and two quarters; how much money has she?

4. How much change will Rebecca get from a \$2-bill and half dollar given in payment for the following purchases?

X 1 doz. bananas	at	\$0.40	
2 lb. butter	at	0.66	
3 pkg. cereal	at	0.18	
Total			\$

5. Make out and balance the following account:

Receipts: Dec. 1, cash on hand, \$120.75; Dec. 6, sale of eggs \$3.50; Dec. 10, sale of poultry, \$8.40; Dec. 13, sale of eggs, \$3.00; Dec. 31, wages, \$120.00.

Expenses: Dec. 10, clothing, \$36.00; Dec. 20, coal, \$14.00; Dec. 20, Christmas gifts, \$26.25; Dec. 31, provisions, \$42.30; Dec. 31, light, \$2.10; Dec. 31, rent, \$30.00.

6. A davenport was advertised in an August furniture sale at \$112.50, which was \$112.50 less than its regular price. What was its regular price?

7. Frank raised 46 heads of cabbage in his garden. 24 of them weighed 6 pounds each, 18 of them 5 pounds each, and the remainder 4 pounds each. He sold 120 pounds of it at 8¢ a pound, 114 pounds at 9¢ a pound, and the remainder at 10¢ a pound. How much did he receive for the 46 heads of cabbage?

8. Grace's father told her that the making of a *budget* consists in dividing your income into exact sums to cover your detailed expenses. He showed her how he made up his family budget for the year and asked her to find his income. What was his income?

BUDGET	
Food	\$829.40
Shelter	374.40
Clothing	304.20
Heat and light	93.60
<i>Savings</i>	364.00
Other expenses	<u>274.40</u>
Total	

10. Find the cost of this playground outfit:

1 Inclined ladder	\$60.00
1 Pair vertical poles	30.00
1 Vertical ladder	48.00
1 Pair inclined poles	37.50
1 Horizontal bar	18.00
1 Hand swing and steps	40.50
1 Pair flying rings	15.00
2 Pairs top handles	12.00
1 Vaulting bar	54.00
1 Tether pole	20.00
1 Swing	35.00
1 Teeter	25.00
1 Children's slide	<u>90.00</u>
Total	

9. The people of Anna's town conducted a six-day campaign to raise money for their hospital. The total amount which had been collected at the *end of each day* was as follows; find the amount collected each day.

SUGGESTION. The sum of the daily collections should be \$2800.00.

	TOTAL	DAILY COLLECTIONS
Mon.	\$ 322.00	?
Tues.	804.25	?
Wed.	1014.50	?
Thur.	1583.75	?
Fri.	2110.00	?
Sat.	<u>2800.00</u>	?
Total		

11. Betsy decided how she wished to furnish her room and on looking up prices found what the cost would be. Find the total cost at the prices which Betsy decided to pay:

Brass bed	\$32.00
Mattress and bed linen	24.75
Dresser	50.00
Writing table	14.50
Chair	4.60
Chair	8.75
Curtains	6.00
Cushion for window seat	<u>9.80</u>
Total	

CHAPTER II

FRACTIONS

Pages 42 to 47 will serve as a review of what you have already studied in fractions and as a preparation for more advanced work in the subject.

1. Numbers like 2, 3, and 5 are called *whole numbers*, or *integers*. Name four other integers.

2. Numbers like $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{3}{2}$ are called *fractions*. Name four other fractions.

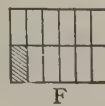
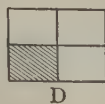
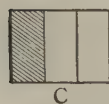
3. Numbers like $1\frac{1}{2}$, $2\frac{3}{4}$, and $3\frac{1}{3}$ are called *mixed numbers*. Name four other mixed numbers.

4. Write as many fractions as you can in 1 minute. Read them.

5. Write as many mixed numbers as you can in 1 minute. Read them.

6. Arrange the following numbers in three columns, writing the integers in the first column, the fractions in the second, and the mixed numbers in the third. Then read each column.

$\frac{1}{2}$	2	$\frac{2}{2}$	$\frac{1}{4}$	$1\frac{1}{4}$	$2\frac{5}{8}$	$\frac{10}{9}$	25
		7	$\frac{1}{3}$	$3\frac{1}{3}$	$\frac{5}{4}$		
A	B	5	$1\frac{3}{8}$	3	$\frac{3}{4}$		
		10	$1\frac{3}{4}$	$2\frac{3}{4}$	9		

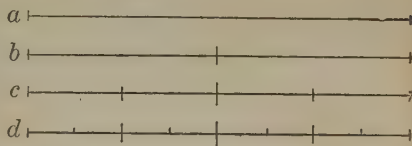


7. Which of these rectangles is divided into *halves*? Which into *fourths*? Into *thirds*? Into *eighths*? Into *twelfths*? Into *sixths*?

8. Observe that the parts of A are equal. What do you notice about the parts of each of the other rectangles?

HALVES, FOURTHS, AND EIGHTHS

Read the following, supplying the missing numbers above the lines. Look at lines *b*, *c*, and *d* if you need to do so.



$$1. \quad 1 = \frac{\quad}{2} \quad 1 = \frac{\quad}{4} \quad 1 = \frac{\quad}{8} \quad \frac{1}{2} = \frac{\quad}{4} \quad \frac{1}{4} = \frac{\quad}{8} \quad \frac{1}{2} = \frac{\quad}{8}$$

$$2. \quad \frac{3}{4} = \frac{\quad}{8} \quad \frac{2}{4} = \frac{\quad}{8} \quad \frac{6}{8} = \frac{\quad}{4} \quad \frac{2}{8} = \frac{\quad}{4} \quad \frac{4}{8} = \frac{\quad}{2} \quad 1\frac{1}{2} = \frac{\quad}{2}$$

$$3. \quad 1\frac{3}{4} = \frac{\quad}{4} \quad 1\frac{1}{8} = \frac{\quad}{8} \quad 1\frac{1}{4} = \frac{\quad}{4} \quad 1\frac{3}{8} = \frac{\quad}{8} \quad 1\frac{5}{8} = \frac{\quad}{8} \quad 1\frac{7}{8} = \frac{\quad}{8}$$

4. Look at *a*, *b*, *c*, and *d* and name three fractions, each equal to 1; name five, each less than 1; name three, each greater than 1.

In your answers to examples 5 and 6 say 1 for $\frac{2}{2}$ or $\frac{4}{4}$ or $\frac{8}{8}$. Say $\frac{1}{2}$ for $\frac{2}{4}$ or $\frac{4}{8}$. Say $\frac{1}{4}$ for $\frac{2}{8}$ and $\frac{3}{8}$ for $\frac{6}{8}$.

5. Add, naming the sums at sight:

6. Subtract, naming the differences at sight:

$$\begin{array}{cccccccccccccccc} \frac{1}{4} & \frac{1}{4} & \frac{1}{8} & \frac{1}{8} & \frac{1}{8} & \frac{1}{8} & \frac{1}{2} & \frac{3}{4} & \frac{3}{8} & \frac{5}{8} & \frac{5}{8} & \frac{7}{8} & \frac{7}{8} & \frac{7}{8} \\ \frac{3}{4} & \frac{1}{4} & \frac{1}{8} & \frac{3}{8} & \frac{7}{8} & \frac{5}{8} & \frac{1}{2} & \frac{1}{4} & \frac{1}{8} & \frac{1}{8} & \frac{3}{8} & \frac{3}{8} & \frac{5}{8} & \frac{1}{8} \end{array}$$

In adding or subtracting *halves* and *fourths*, change *halves* to *fourths*; in adding or subtracting *halves* and *eighths*, change *halves* to *eighths*. What must you do in adding or subtracting *fourths* and *eighths*?

7. Add, naming the sums at sight:

8. Subtract, naming the differences at sight:

$$\begin{array}{cccccccccccc} \frac{1}{4} & \frac{1}{2} & \frac{1}{2} & \frac{1}{4} & \frac{1}{4} & \frac{1}{2} & \frac{1}{4} & \frac{1}{2} & \frac{3}{4} & \frac{5}{8} & \frac{7}{8} \\ \frac{1}{8} & \frac{1}{8} & \frac{3}{8} & \frac{3}{8} & \frac{5}{8} & \frac{1}{4} & \frac{1}{8} & \frac{3}{8} & \frac{1}{2} & \frac{1}{2} & \frac{3}{4} \end{array}$$

9. Count this way: $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, and so on to 5; to 8.

10. Count this way: $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, and so on to 3; to 6.

HALVES, FOURTHS, AND EIGHTHS

1. Caroline gave each of the seven girls who attended her birthday party a half-pound box of homemade candy. How many pounds of candy did she give them?

Write $\frac{7}{2}$ lb. = $3\frac{1}{2}$ lb.

2. Name the whole or mixed number equal to each of these fractions:

$\frac{2}{2}$	$\frac{4}{4}$	$\frac{5}{2}$	$\frac{9}{2}$	$\frac{8}{4}$	$\frac{7}{4}$	$\frac{9}{4}$	$\frac{11}{4}$	$\frac{7}{2}$	$\frac{15}{4}$	$\frac{9}{8}$	$\frac{17}{8}$
$\frac{4}{2}$	$\frac{3}{2}$	$\frac{6}{2}$	$\frac{11}{2}$	$\frac{5}{4}$	$\frac{8}{2}$	$\frac{12}{4}$	$\frac{10}{2}$	$\frac{12}{2}$	$\frac{19}{4}$	$\frac{11}{8}$	$\frac{25}{8}$

3. Add, naming sums only. Use whole numbers or mixed numbers instead of fractions when the answer is equal to 1 or more than 1.

$\frac{2}{4}$	$\frac{4}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{2}$ (or $\frac{2}{4}$)	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$
$\frac{2}{4}$	$\frac{5}{8}$	$\frac{7}{8}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{3}{4}$ (or $\frac{6}{8}$)	$\frac{5}{8}$	$\frac{5}{8}$

4. Add, naming sums only; add the fractions, then the whole numbers. Be careful how you name the answers in *b* and *e*.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
$1\frac{1}{2}$	$1\frac{1}{4}$	$2\frac{1}{4}$	$2\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{3}{4}$	$1\frac{3}{4}$	$2\frac{5}{8}$
$1\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$1\frac{1}{2}$

5. Subtract at sight; subtract the fractions, then the whole numbers. Be careful how you name the answers in *b*, *d*, and *e*.

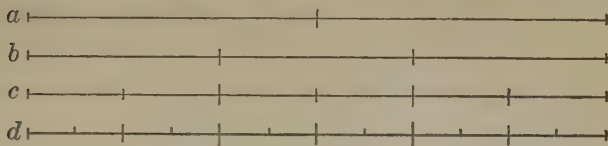
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
$2\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{1}{2}$	$1\frac{5}{8}$	$2\frac{5}{8}$	$3\frac{3}{4}$	$2\frac{5}{8}$	$2\frac{3}{8}$
$1\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{1}{8}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{4}$

6. Subtract each of these fractions from 1, then from 2; name the answers at sight:

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{5}{8}$	$\frac{7}{8}$
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HALVES, THIRDS, SIXTHS, AND TWELFTHS

1. Tell into how many equal parts each of these lines is divided.



2. Draw four lines of equal length; divide the first into halves, the second into thirds, the third into sixths, and the fourth into twelfths.

3. Read, supplying the missing numbers. Look at lines *a*, *b*, *c*, and *d* if you need to do so.

$$\begin{array}{llllll}
 1 = \frac{1}{2} & 1 = \frac{1}{3} & 1 = \frac{1}{6} & 1 = \frac{1}{12} & \frac{1}{2} = \frac{1}{6} & \frac{1}{3} = \frac{1}{6} \\
 \frac{2}{3} = \frac{4}{6} & \frac{4}{6} = \frac{2}{3} & \frac{3}{6} = \frac{1}{2} & \frac{1}{3} = \frac{4}{12} & \frac{2}{3} = \frac{8}{12} & \frac{3}{6} = \frac{8}{12} \\
 \frac{4}{12} = \frac{1}{3} & \frac{6}{12} = \frac{1}{2} & \frac{8}{12} = \frac{2}{3} & \frac{5}{6} = \frac{10}{12} & \frac{2}{6} = \frac{4}{12} & \frac{10}{12} = \frac{5}{6}
 \end{array}$$

4. Read these fractions and name the whole or mixed number equal to each. In your answer say $\frac{1}{2}$ for $\frac{3}{6}$ or $\frac{6}{12}$, $\frac{2}{3}$ for $\frac{4}{6}$ or $\frac{8}{12}$, etc.

$$\begin{array}{llllll}
 \frac{4}{3} & \frac{3}{3} & \frac{5}{3} & \frac{6}{6} & \frac{12}{12} & \frac{18}{12} & \frac{11}{6} \\
 \frac{9}{6} & \frac{10}{6} & \frac{6}{3} & \frac{8}{3} & \frac{10}{3} & \frac{16}{12} & \frac{20}{12}
 \end{array}$$

5. Count this way: $\frac{1}{3}$, $\frac{2}{3}$, 1, $1\frac{1}{3}$, and so on to 4.

6. Count this way: $\frac{1}{6}$, $\frac{1}{3}$, $\frac{1}{2}$, $\frac{2}{3}$, $\frac{5}{6}$, 1, and so on to 3.

ADDING HALVES, THIRDS, SIXTHS, AND TWELFTHS

1. In making a doll's dress Martha used $\frac{1}{2}$ yd. of gingham and $\frac{1}{3}$ yd. of linen. How much of both did she use?

Think $\frac{2}{6}$ for $\frac{1}{3}$ and $\frac{4}{6}$ for $\frac{2}{3}$.

2. In adding *halves* and *sixths* what do you think for $\frac{1}{2}$?

3. In adding *thirds* and *sixths* what do you think for $\frac{1}{3}$? $\frac{2}{6}$?

4. Tell how you think of each of these when you are adding to twelfths: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{6}$, $\frac{5}{6}$.

5. Add. Remember what to do when the sum is 1 or more. Be careful how you state the sums in *b* and *c*.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
$\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{12}$	$\frac{1}{4}$
$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{3}$	$\frac{1}{6}$	$\frac{5}{12}$	$\frac{7}{12}$	$\frac{5}{6}$	$\frac{1}{2}$

6. Florence used $1\frac{5}{6}$ yd. of lawn for a blouse and $\frac{1}{2}$ yd. of organdie for the collars and cuffs. How many yards of both kinds did she use?

Think $\frac{3}{6}$ for $\frac{1}{2}$; add the fractions and think $1\frac{1}{3}$ for $\frac{4}{3}$.

7. Add. Remember what to do when the sum of the fraction is 1 or more. Be careful how you state the sums in *b* and *e*.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
$1\frac{1}{3}$	$2\frac{1}{3}$	$1\frac{1}{6}$	$1\frac{2}{3}$	$1\frac{5}{6}$	$1\frac{1}{3}$	$2\frac{1}{2}$	$2\frac{1}{4}$
$1\frac{1}{3}$	$1\frac{2}{3}$	$1\frac{1}{2}$	$2\frac{1}{6}$	$2\frac{1}{2}$	$2\frac{5}{6}$	$3\frac{1}{3}$	$1\frac{1}{2}$

SUBTRACTING HALVES, THIRDS, SIXTHS, AND TWELFTHS

1. Subtract each of these fractions from 1:

$\frac{1}{3}$	$\frac{2}{3}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{1}{12}$	$\frac{5}{12}$	$\frac{7}{12}$	$\frac{11}{12}$
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2. Draw on a sheet of paper a line $\frac{1}{2}$ foot long. Divide the line into two parts by placing a point on the line $\frac{1}{3}$ foot from one end of it. How long is the shorter part of the line? the longer part?

Think $\frac{1}{2} = \frac{3}{6}$ and $\frac{1}{3} = \frac{2}{6}$.

3. Again study carefully examples 1-4, at the foot of page 44, and tell what to do in subtracting *halves* and *thirds*; *halves* and *sixths*; *thirds* and *sixths*; *halves*, *thirds*, or *sixths* and *twelfths*.

4. Subtract. Be careful how you give the answers to *b*, *e*, and *g*.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
$\frac{2}{3}$	$\frac{5}{6}$	$\frac{1}{2}$	$\frac{7}{12}$	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{2}{3}$
$\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{5}{12}$

5. Anna and Myrtle had a piece of ribbon $3\frac{1}{3}$ yd. long from which they cut a piece $1\frac{1}{2}$ yd. long to make badges. How long was the piece that was left?

Think $3\frac{2}{3}$ for $3\frac{1}{3}$ and $1\frac{3}{6}$ for $1\frac{1}{2}$. Change 1 of the 3 to $\frac{2}{3}$.

6. Subtract. Be careful how you give the answers to *b* and *d*.

	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
$\frac{2}{3}$	$3\frac{1}{2}$	$2\frac{1}{3}$	$2\frac{5}{8}$	$3\frac{7}{12}$	$3\frac{5}{12}$	$3\frac{1}{2}$	$3\frac{1}{2}$
$\frac{1}{3}$	$1\frac{1}{6}$	$1\frac{1}{6}$	$1\frac{1}{3}$	$1\frac{1}{2}$	$1\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{2}{3}$

FRACTIONAL PARTS OF WHOLE NUMBERS

1. James earned 30¢ and saved *one half* of it. How much did he save?

Think $30 \div 2 = ?$

To find *one half* of a number we divide the number by 2; to find *one third* of a number we divide the number by 3.

2. How do we find *one fourth* of a number? *one sixth* of it? *one eighth* of it? *one twelfth* of it?

3. Name the answer in each of the following; try to finish all less than 1 minute:

of 4	$\frac{1}{2}$ of 10	$\frac{1}{2}$ of 24	$\frac{1}{2}$ of 36	$\frac{1}{2}$ of 22
of 8	$\frac{1}{4}$ of 16	$\frac{1}{3}$ of 24	$\frac{1}{3}$ of 36	$\frac{1}{3}$ of 33
of 6	$\frac{1}{3}$ of 15	$\frac{1}{4}$ of 24	$\frac{1}{4}$ of 36	$\frac{1}{4}$ of 40
of 9	$\frac{1}{6}$ of 18	$\frac{1}{6}$ of 24	$\frac{1}{6}$ of 36	$\frac{1}{6}$ of 42
of 12	$\frac{1}{8}$ of 32	$\frac{1}{8}$ of 24	$\frac{1}{12}$ of 36	$\frac{1}{12}$ of 48

4. Mrs. Raymond bought 6 yd. of gingham and used $\frac{2}{3}$ of it to make Katharine a dress. How much of the gingham did she use for Katharine's dress?

Think 2 times $\frac{1}{3}$ of 6.

5. Name at sight the answer in each of the following:

$\frac{2}{3}$ of 12	$\frac{2}{3}$ of 24	$\frac{2}{3}$ of 30	$\frac{2}{3}$ of 36	$\frac{2}{3}$ of 2
$\frac{3}{4}$ of 12	$\frac{3}{4}$ of 24	$\frac{3}{4}$ of 28	$\frac{3}{4}$ of 36	$\frac{4}{5}$ of 3
$\frac{5}{8}$ of 12	$\frac{5}{8}$ of 24	$\frac{5}{8}$ of 30	$\frac{5}{8}$ of 36	$\frac{5}{8}$ of 3
$\frac{5}{8}$ of 18	$\frac{3}{8}$ of 24	$\frac{2}{3}$ of 18	$\frac{5}{12}$ of 24	$\frac{5}{8}$ of 4

6. When lace is selling at 48¢ a yard, what should you pay for $\frac{1}{2}$ yd.? $\frac{3}{4}$ yd.? $\frac{3}{8}$ yd.? $\frac{5}{8}$ yd.? $\frac{2}{3}$ yd.?

Terms of a Fraction. In $\frac{1}{2}$ or $\frac{3}{4}$ or $\frac{6}{5}$ the 1 or 3 or 6 is called the *numerator*; the 2 or 4 or 5 is called the *denominator*. The numerator and the denominator are called the *terms* of the fraction.

MEANING AND USE OF NUMERATOR AND DENOMINATOR

1. Write ten fractions in a column; name the numerators; name the denominators; read the fractions. Tell whether each fraction is greater or less than 1.

2. In reading a fraction, which of its terms do you read first?

3. Write in figures:

two thirds	seven twelfths	one sixteenth
eight thirds	seven halves	nine fourths

4. Which of the terms of $\frac{3}{4}$ shows that the fraction means *fourths*? Which term of $\frac{3}{4}$ shows *how many* fourths are used?

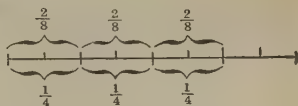
5. Which term of a fraction tells the *size* of the parts? Which tells the *number* of parts used?

6. With your ruler draw a line 4 in. long and show $\frac{3}{4}$ of it. Into how many equal parts did you divide the line? How many equal parts did you use?

7. Draw three lines each 6 in. long. Show $\frac{1}{2}$ of the first; $\frac{1}{3}$ of the second; $\frac{5}{8}$ of the third.

Changing a Fraction without Changing Its Value. Before we add or subtract fractions which do not have the same denominator, as $\frac{3}{4}$ and $\frac{5}{8}$, we must express them as fractions having the same denominator. For example, $\frac{3}{4}$ and $\frac{5}{8}$ may be added or subtracted when both are expressed as *eighths*. In changing $\frac{3}{4}$ to eighths, we do not increase or decrease the value of the $\frac{3}{4}$.

Multiplying Both Terms of a Fraction by the Same Number. If both terms of $\frac{3}{4}$ are multiplied by any number, as 2, the $\frac{3}{4}$ is changed to $\frac{6}{8}$. You can see from the diagram that $\frac{3}{4}$ equals $\frac{6}{8}$. $\frac{3}{4}$ has been neither increased nor decreased, and we say its value has not been changed.



Multiplying both terms of a fraction by the same number does not change the value of the fraction.

Reducing Fractions to Higher Terms. Multiplying both terms of a fraction by 2, 3, 4, or any larger number is called *reducing the fraction to higher terms*.

REDUCING FRACTIONS TO HIGHER TERMS

1. Multiply at sight both terms of each of these fractions by 2 :

$$\frac{1}{4} \quad \frac{1}{3} \quad \frac{2}{3} \quad \frac{3}{4} \quad \frac{1}{8} \quad \frac{3}{8} \quad \frac{5}{8} \quad \frac{1}{6}$$

Say $\frac{1}{2} = \frac{2}{4}$, $\frac{1}{4} = \frac{2}{8}$, and so on.

2. Read, stating at sight the missing numbers :

$$\frac{1}{2} = \frac{\quad}{4} = \frac{\quad}{6} = \frac{\quad}{8} = \frac{\quad}{10} = \frac{\quad}{12} = \frac{\quad}{16} \qquad \frac{3}{4} = \frac{\quad}{8} = \frac{\quad}{12} = \frac{\quad}{16}$$

3. Reduce each of these fractions to *twelfths*; to *twenty-fourths* :

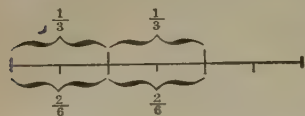
$$\frac{1}{3} \quad \frac{2}{3} \quad \frac{1}{4} \quad \frac{1}{6} \quad \frac{3}{4} \quad \frac{5}{6}$$

4. Reduce each of these fractions to *sixteenths*; to *thirty-seconds* :

$$\frac{1}{4} \quad \frac{1}{8} \quad \frac{3}{4} \quad \frac{5}{8} \quad \frac{3}{8} \quad \frac{7}{8}$$

Dividing Both Terms of a Fraction by the Same Number

When both terms of $\frac{4}{6}$ are divided by 2, thus: $\frac{4 \div 2}{6 \div 2}$, the fraction



$\frac{4}{6}$ is changed to $\frac{2}{3}$. You can see from the diagram that $\frac{4}{6} = \frac{2}{3}$.

Dividing both terms of a fraction by the same number does not change

the value of the fraction.

Reducing to Lower Terms. Dividing both terms of a fraction by 2, 3, 4, or any larger whole number is called *reducing the fraction to lower terms*.

Lowest Terms. A fraction is said to be in *lowest terms* when the numerator and the denominator cannot *both* be divided by any whole number *greater than 1*, without a remainder.

$\frac{1}{4}$, $\frac{3}{8}$, $\frac{5}{8}$, $1\frac{7}{12}$, and $2\frac{5}{8}$ are in lowest terms. Why?

$\frac{2}{6}$, $\frac{4}{8}$, $\frac{6}{8}$, $1\frac{8}{12}$, and $1\frac{3}{4}$ are not in lowest terms. Why?

Reduction. Changing the form of a fraction without changing its value is called *reduction*.

REDUCING FRACTIONS TO LOWEST TERMS

1. Divide both terms of each of these fractions by 2. Is each result in lowest terms?

$$\frac{4}{6} \quad \frac{2}{8} \quad \frac{10}{12} \quad \frac{2}{4} \quad \frac{6}{8} \quad \frac{8}{10} \quad \frac{2}{12} \quad \frac{10}{16} \quad \frac{8}{12} \quad \frac{1}{1}$$

Say $\frac{4}{6} = \frac{2}{3}$, and so on.

2. Which of the following fractions are in lowest terms? Express the others in lowest terms.

$$\frac{2}{2} \quad \frac{3}{3} \quad \frac{4}{4} \quad \frac{12}{4} \quad \frac{2}{8} \quad \frac{15}{8} \quad \frac{9}{12} \quad \frac{5}{16} \quad \frac{1}{2} \quad \frac{1}{3} \quad \frac{1}{4} \quad \frac{13}{8} \quad \frac{4}{8} \quad 1\frac{4}{12} \quad \frac{2}{16} \quad \frac{12}{16}$$

ADDITION AND SUBTRACTION INVOLVING REDUCTION OF FRACTIONS

When you have added or subtracted and there is a fraction in the answer, be sure that the fraction is expressed in lowest terms.

1. In adding *halves* and *fourths*, how do you think of *halves*?
In adding fractions, think carefully what you must do when the fractions do not have the same denominator.

2. Add, naming sums at sight :

$$\begin{array}{cccccccccc} \frac{1}{8} & \frac{1}{8} & \frac{1}{8} & \frac{1}{2} & \frac{1}{2} & \frac{1}{6} & \frac{3}{10} & \frac{7}{12} & \frac{1}{3} \\ \frac{1}{8} & \frac{3}{8} & \frac{5}{8} & \frac{1}{8} & \frac{3}{8} & \frac{1}{3} & \frac{1}{5} & \frac{1}{4} & \frac{5}{12} \end{array}$$

3. Add, naming as many sums as possible at sight :

$$\begin{array}{cccccccccc} \frac{1}{8} & 2\frac{1}{6} & 1\frac{7}{12} & 1\frac{5}{16} & 1\frac{1}{2} & 3\frac{1}{6} & 1\frac{1}{6} & 1\frac{2}{3} & 1\frac{7}{12} & 2\frac{1}{3} \\ \frac{1}{8} & 1\frac{1}{6} & 1\frac{1}{12} & 2\frac{1}{16} & 2\frac{1}{4} & 1\frac{1}{3} & 2\frac{1}{2} & 1\frac{1}{12} & 1\frac{1}{4} & 1\frac{5}{12} \end{array}$$

4. In subtracting *thirds* and *sixths*, how do you think of *thirds*?
In subtracting fractions, think carefully what you must do when the fractions do not have the same denominator.

5. Subtract, naming as many differences as possible at sight :

$$\begin{array}{cccccccccc} \frac{3}{8} & \frac{5}{6} & \frac{7}{12} & \frac{5}{6} & \frac{5}{6} & \frac{7}{12} & \frac{7}{12} & \frac{7}{10} & \frac{9}{10} \\ \frac{1}{8} & \frac{1}{6} & \frac{5}{12} & \frac{1}{2} & \frac{1}{3} & \frac{1}{3} & \frac{1}{4} & \frac{1}{5} & \frac{1}{2} \end{array}$$

6. Subtract, naming as many differences as possible at sight :

$$\begin{array}{cccccccccc} \frac{5}{8} & 1\frac{5}{6} & 2\frac{1}{2} & 3\frac{1}{2} & 3\frac{5}{6} & 2\frac{5}{6} & 2\frac{3}{4} & 2\frac{7}{12} & 2\frac{3}{4} & 3\frac{9}{10} \\ \frac{1}{8} & 1\frac{1}{2} & 1\frac{1}{4} & 1\frac{1}{6} & 1\frac{1}{2} & 1\frac{1}{3} & 1\frac{1}{12} & 1\frac{1}{4} & 1\frac{5}{12} & 1\frac{2}{5} \end{array}$$

Proper Fraction. If the numerator of a fraction is less than the denominator, as in $\frac{3}{4}$, the fraction is less than 1. A fraction which is less than 1 is called a *proper fraction*.

Name five proper fractions.



Improper Fraction. If the numerator of a fraction is equal to the denominator, as in $\frac{4}{4}$, the fraction is equal to 1.

Name five fractions each equal to 1.



If the numerator of a fraction is greater than the denominator, as in $\frac{5}{4}$, the fraction is greater than 1.



A fraction which is equal to 1 or greater than 1 is called an *improper fraction*.

Mixed Number. A number made up of an integer and a fraction is called a *mixed number*.

CLASSIFYING FRACTIONS, MIXED NUMBERS, AND INTEGERS

1. Write all the proper fractions which you can having 5 the denominator of each. Name six other proper fractions.

2. Write four fractions each no greater than 1 and having 10 for the denominator. How many of them are proper fractions?

Of the following numbers, name first the integers, then the mixed numbers, then the improper fractions:

3.	$2\frac{1}{2}$	$\frac{6}{5}$	$\frac{5}{2}$	$\frac{7}{3}$	$\frac{10}{3}$	$7\frac{1}{2}$	$\frac{10}{12}$	1	$\frac{4}{4}$
4.	$\frac{2}{2}$	$\frac{3}{3}$	$1\frac{2}{3}$	$\frac{3}{8}$	$\frac{3}{10}$	$\frac{6}{2}$	$1\frac{4}{6}$	$3\frac{5}{10}$	$\frac{12}{3}$
5.	$\frac{2}{3}$	$\frac{4}{3}$	7	$\frac{8}{3}$	$\frac{5}{10}$	$\frac{2}{6}$	$\frac{16}{8}$	$\frac{3}{12}$	3
6.	$\frac{3}{2}$	5	$\frac{5}{6}$	$1\frac{1}{8}$	$3\frac{1}{3}$	$\frac{7}{6}$	$\frac{12}{6}$	$\frac{14}{2}$	$1\frac{7}{8}$

7. Name the fractions in examples 3 to 6 which are not in lowest terms.

REDUCING WHOLE OR MIXED NUMBERS TO FRACTIONS

1. Reduce $3\frac{1}{2}$ to halves.

1 = 2 halves.

3 = 3×2 halves, or 6 halves.

6 halves + 1 half = 7 halves. *Ans.* $\frac{7}{2}$.

To get the numerator of the answer quickly, multiply 3 by 2 and add 1 to the product. Try this method in the following examples.

NOTE. In working with fractions it is necessary sometimes to change (reduce) whole numbers and mixed numbers to fractions. In your work following this page, be on the lookout for instances in which you will do this.

2. Reduce at sight each of these numbers to *halves*; *thirds*; *fourths*; *sixths*:

1 2 4 3 5 10 6 8

Say $1 = \frac{2}{2} = \frac{3}{3}$, and so on; say $2 = \frac{4}{2} = \frac{6}{3}$, and so on.

Reduce to improper fractions, naming as many results as possible at sight:

3. $1\frac{1}{2}$ $2\frac{1}{2}$ $6\frac{2}{3}$ $1\frac{1}{6}$ $1\frac{5}{6}$ $1\frac{7}{8}$ $2\frac{3}{8}$ $3\frac{5}{8}$ $2\frac{2}{5}$ $1\frac{3}{5}$

4. $2\frac{1}{3}$ $3\frac{1}{2}$ $5\frac{3}{8}$ $1\frac{3}{4}$ $2\frac{1}{4}$ $3\frac{3}{4}$ $11\frac{1}{9}$ $5\frac{5}{9}$ $16\frac{1}{2}$ $18\frac{3}{4}$

5. $2\frac{2}{3}$ $7\frac{1}{2}$ $6\frac{1}{4}$ $12\frac{1}{2}$ $16\frac{2}{3}$ $14\frac{2}{7}$ $55\frac{5}{9}$ $22\frac{1}{2}$ $4\frac{1}{6}$ $37\frac{1}{2}$

6. $3\frac{1}{3}$ $4\frac{1}{2}$ $8\frac{1}{3}$ $33\frac{1}{3}$ $66\frac{2}{3}$ $28\frac{4}{7}$ $62\frac{1}{2}$ $22\frac{2}{9}$ $42\frac{6}{7}$ $44\frac{4}{9}$

7. A \$1-bill is worth how many half dollars? how many quarters? how many dimes? Answer these same questions about a \$2-bill; a \$5-bill.

8. Harriet used $3\frac{3}{8}$ yd. of ribbon to make badges; she used yd. to make each badge. How many badges did she make?

9. John measured $12\frac{1}{2}$ bu. of wheat with a half-bushel measure. How many times had he to fill this measure?

10. Tell how to change a mixed number to a fraction.

REDUCING AN IMPROPER FRACTION TO A WHOLE NUMBER OR A MIXED NUMBER

1. Reduce $\frac{5}{2}$ to a mixed number.

$$\frac{5}{2} = \frac{2)5}{2\frac{1}{2}}$$

Since $\frac{1}{2}$ means $1 \div 2$,

$\frac{5}{2}$ may be thought of as $5 \div 2$, or $2\frac{1}{2}$.

NOTE. In your work following this page be on the lookout for instances which you will reduce an improper fraction to a mixed number.

Express each of these fractions as a whole number or a mixed number, giving as many of the answers as you can at sight. All fractions in the answers must be in lowest terms.

2. $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{4}{2}$ $\frac{6}{3}$ $\frac{6}{2}$ $\frac{8}{2}$ $\frac{10}{5}$ $\frac{12}{4}$ $\frac{12}{3}$

In examples 3 to 5, reduce each fraction to a whole number or a mixed number:

3.	$\frac{8}{8}$	$\frac{3}{2}$	$\frac{7}{2}$	$\frac{9}{2}$	$\frac{15}{2}$	$\frac{11}{2}$	$\frac{25}{2}$	$\frac{75}{2}$	$\frac{40}{3}$	$\frac{20}{3}$
4.	$\frac{5}{3}$	$\frac{8}{3}$	$\frac{4}{3}$	$\frac{9}{4}$	$\frac{10}{3}$	$\frac{15}{4}$	$\frac{13}{4}$	$\frac{25}{4}$	$\frac{75}{4}$	$\frac{50}{3}$
5.	$\frac{8}{6}$	$\frac{6}{4}$	$\frac{10}{6}$	$\frac{10}{8}$	$\frac{25}{8}$	$\frac{75}{8}$	$\frac{12}{5}$	$\frac{16}{5}$	$\frac{25}{12}$	$\frac{35}{16}$
6.	$\frac{25}{6}$	$\frac{10}{4}$	$\frac{100}{5}$	$\frac{125}{2}$	$\frac{175}{2}$	$\frac{100}{3}$	$\frac{200}{3}$	$\frac{100}{9}$	$\frac{100}{7}$	$\frac{200}{9}$

7. James exchanged 12 quarter dollars for dollar bills. How many dollar bills did he receive?

8. Mary bought a half-pint box of ice cream for herself and one for each of two school friends. How many pints of ice cream did she buy?

9. Lewis wishes to draw a line which he can divide exactly into 15 eighth-inch lengths. How many inches long must he make the line? How long must he draw a line if he wishes to divide it exactly into 16 quarter-inch lengths?

Common Denominator. In order to find the sum of $\frac{2}{3}$ and $\frac{1}{4}$ or the difference between $\frac{2}{3}$ and $\frac{1}{4}$, we must first change them to fractions having the same denominator (*a common denominator*).

Two or more fractions have more than one common denominator; for example, $\frac{3}{4}$ and $\frac{1}{2}$:

$\frac{3}{4} = \frac{3}{4} = \frac{6}{8} = \frac{9}{12}$ Here the denominator 4 or 8 or 12 is a common denominator
 $\frac{1}{2} = \frac{2}{4} = \frac{4}{8} = \frac{6}{12}$ of $\frac{3}{4}$ and $\frac{1}{2}$.

Name the smallest or *least* of the three common denominators.

Have $\frac{3}{4}$ and $\frac{1}{2}$ other common denominators than 4, 8, and 12?

Name two common denominators of: $\frac{1}{4}$ and $\frac{1}{8}$; $\frac{1}{3}$ and $\frac{1}{6}$; and $\frac{1}{3}$; $\frac{1}{2}$ and $\frac{1}{10}$.

Similar Fractions. Fractions which have a common denominator are sometimes called *like fractions* or *similar fractions*.

Least Common Denominator. The least number that can be used as a common denominator of two or more fractions is called their *least common denominator*.

What is the least common denominator of $\frac{3}{4}$ and $\frac{1}{2}$?

Here is a quick way of finding the least common denominator of two or more fractions: **Find the least number which the denominators of the fractions will divide, without a remainder; that is, will exactly divide.**

1. What is the least number which is exactly divisible by 2 and 3? 3 and 4? 4 and 6? 3 and 8? 2 and 5? 4 and 5?

2. What is the least common denominator of: $\frac{1}{2}$ and $\frac{1}{3}$? $\frac{1}{3}$ and $\frac{1}{4}$? $\frac{1}{4}$ and $\frac{1}{6}$? $\frac{1}{3}$ and $\frac{1}{8}$? $\frac{1}{2}$ and $\frac{1}{5}$? $\frac{1}{4}$ and $\frac{1}{5}$?

REDUCING TO LEAST COMMON DENOMINATOR

For each pair of the following fractions state at sight: (1) the least common denominator; (2) the pairs of fractions which have the least common denominator for a denominator. Thus, for 1, say 4, $\frac{2}{4}, \frac{1}{4}$; for 5, f , say 6, $\frac{3}{6}, \frac{2}{6}$. L. C. D. stands for least common denominator.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
1.	$\frac{1}{2}, \frac{1}{4}$	$\frac{1}{2}, \frac{1}{6}$	$\frac{1}{2}, \frac{1}{8}$	$\frac{1}{3}, \frac{1}{6}$	$\frac{1}{4}, \frac{1}{8}$	$\frac{1}{2}, \frac{1}{10}$	$\frac{1}{5}, \frac{1}{10}$
2.	$\frac{1}{2}, \frac{1}{12}$	$\frac{1}{2}, \frac{3}{4}$	$\frac{1}{2}, \frac{5}{6}$	$\frac{1}{3}, \frac{5}{6}$	$\frac{1}{2}, \frac{3}{8}$	$\frac{2}{3}, \frac{1}{6}$	$\frac{5}{6}, \frac{1}{12}$
3.	$\frac{1}{2}, \frac{1}{16}$	$\frac{2}{3}, \frac{5}{6}$	$\frac{1}{6}, \frac{5}{12}$	$\frac{5}{12}, \frac{1}{3}$	$\frac{2}{3}, \frac{1}{12}$	$\frac{1}{2}, \frac{7}{12}$	$\frac{1}{4}, \frac{5}{8}$
4.	$\frac{1}{2}, \frac{5}{12}$	$\frac{1}{3}, \frac{1}{12}$	$\frac{1}{4}, \frac{3}{8}$	$\frac{1}{4}, \frac{5}{12}$	$\frac{1}{8}, \frac{7}{16}$	$\frac{3}{4}, \frac{3}{8}$	$\frac{5}{8}, \frac{3}{16}$
5.	$\frac{1}{8}, \frac{1}{16}$	$\frac{3}{4}, \frac{1}{16}$	$\frac{1}{2}, \frac{3}{8}$	$\frac{1}{4}, \frac{5}{6}$	$\frac{5}{6}, \frac{7}{12}$	$\frac{1}{2}, \frac{1}{3}$	$\frac{1}{4}, \frac{1}{3}$
6.	$\frac{7}{12}, \frac{1}{3}$	$\frac{3}{4}, \frac{5}{12}$	$\frac{3}{4}, \frac{1}{6}$	$\frac{1}{3}, \frac{1}{8}$	$\frac{2}{3}, \frac{3}{4}$	$\frac{3}{4}, \frac{5}{6}$	$\frac{1}{2}, \frac{1}{5}$
7.	$\frac{1}{4}, \frac{7}{8}$	$\frac{5}{8}, \frac{5}{16}$	$\frac{1}{4}, \frac{7}{10}$	$\frac{3}{4}, \frac{2}{5}$	$\frac{2}{3}, \frac{5}{8}$	$\frac{1}{2}, \frac{3}{5}$	$\frac{1}{2}, \frac{9}{10}$
8.	$\frac{1}{3}, \frac{3}{4}$	$\frac{3}{5}, \frac{8}{10}$	$\frac{5}{8}, \frac{1}{6}$	$\frac{5}{8}, \frac{1}{12}$	$\frac{5}{6}, \frac{1}{8}$	$\frac{1}{6}, \frac{3}{8}$	$\frac{1}{8}, \frac{1}{12}$
9.	$\frac{2}{3}, \frac{1}{8}$	$\frac{3}{4}, \frac{4}{5}$	$\frac{5}{6}, \frac{1}{4}$	$\frac{3}{8}, \frac{5}{12}$	$\frac{3}{4}, \frac{3}{10}$	$\frac{5}{6}, \frac{3}{8}$	$\frac{2}{3}, \frac{7}{8}$

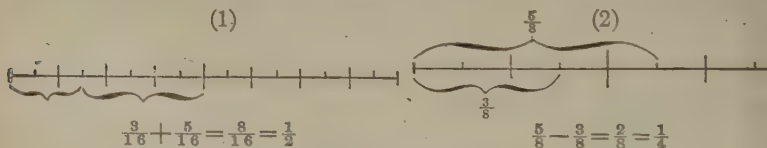
10. Write six pairs of fractions having the fractions of each pair unlike. Reduce the fractions of each pair to the L. C. D.

Reduce the fractional parts of the following pairs of mixed numbers to fractions having the least common denominator:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
11. $2\frac{1}{2}, 1\frac{3}{4}$	$3\frac{5}{6}, 7\frac{1}{2}$	$1\frac{1}{2}, 2\frac{1}{3}$	$1\frac{1}{3}, 1\frac{1}{4}$	$4\frac{1}{2}, 2\frac{2}{3}$	$5\frac{3}{4}$
12. $2\frac{3}{4}, 3\frac{5}{6}$	$1\frac{1}{2}, 2\frac{2}{5}$	$3\frac{3}{8}, 2\frac{5}{12}$	$2\frac{2}{5}, 4\frac{3}{4}$	$3\frac{2}{3}, 5\frac{5}{8}$	$7\frac{3}{8}$

Adding and Subtracting Similar Fractions. You have already had much practice in adding fractions having a common denominator and in subtracting two such fractions; also in reducing fractions to lowest terms and improper fractions to whole mixed numbers. The next exercise is intended as a further review of such work.

Fractions having a common denominator are added in the manner shown in diagram (1) and subtracted as shown in (2).



In adding and subtracting similar fractions, *think* :

For the sum : Numerator is the sum of the numerators; denominator is the common denominator.

For the difference : Numerator is the difference of the numerators; denominator is the common denominator.

DRILL IN ADDING AND SUBTRACTING SIMILAR FRACTIONS

Add at sight each pair of these fractions; then subtract two in each pair. Your answers should contain no improper fractions and no fractions not in lowest terms.

$\frac{1}{3}$	$\frac{3}{5}$	$\frac{5}{9}$	$\frac{5}{7}$	$\frac{3}{5}$	$\frac{5}{6}$	$\frac{7}{8}$	$\frac{4}{5}$	$\frac{4}{5}$	$\frac{3}{9}$	$\frac{7}{9}$	$\frac{3}{9}$
$\frac{1}{3}$	$\frac{1}{5}$	$\frac{2}{9}$	$\frac{1}{7}$	$\frac{2}{5}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{3}{5}$	$\frac{2}{5}$	$\frac{5}{9}$	$\frac{5}{9}$	$\frac{7}{9}$
$\frac{7}{12}$	$\frac{3}{10}$	$\frac{3}{16}$	$\frac{11}{16}$	$\frac{7}{10}$	$\frac{11}{12}$	$\frac{15}{16}$	$\frac{8}{9}$	$\frac{9}{10}$	$\frac{15}{16}$	$\frac{11}{16}$	$\frac{15}{16}$
$\frac{1}{12}$	$\frac{1}{10}$	$\frac{1}{16}$	$\frac{3}{16}$	$\frac{1}{10}$	$\frac{5}{12}$	$\frac{3}{16}$	$\frac{4}{9}$	$\frac{7}{10}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{9}{16}$

How to Add Unlike Fractions. Fractions that do not have a common denominator (*unlike fractions*) must be reduced to similar fractions before they can be added.

Study how the sums in (1), (2), (3), (4), and (5) are found :

(1)	(2)	(3)	(4)	(5)
$\frac{1}{3} = \frac{4}{12}$	$\frac{1}{3} = \frac{4}{12}$	$\frac{3}{10} = \frac{9}{30}$	$\frac{3}{4} = \frac{9}{12}$	$\frac{5}{6} = \frac{10}{12}$
$\frac{2}{3} = \frac{8}{12}$	$\frac{1}{4} = \frac{3}{12}$	$\frac{1}{6} = \frac{5}{30}$	$\frac{2}{3} = \frac{8}{12}$	$\frac{2}{3} = \frac{8}{12}$
$\frac{1}{6} = \frac{2}{12}$	Sum = $\frac{7}{12}$	Sum = $\frac{14}{30} = \frac{7}{15}$	Sum = $\frac{17}{12} = 1\frac{5}{12}$	Sum = $\frac{18}{12} = \frac{3}{2} = 1\frac{1}{2}$

ADDITION OF UNLIKE FRACTIONS

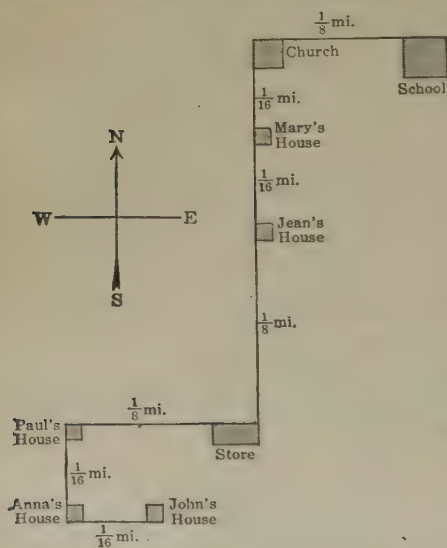
Add, naming as many sums as you can at sight. The answers should contain no improper fractions and no fractions not in best terms.

$\frac{1}{4}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{5}{6}$	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{1}{4}$	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{9}{10}$
$\frac{1}{2}$	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{10}$	$\frac{1}{6}$
$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{6}$	$\frac{3}{4}$	$\frac{1}{3}$	$\frac{4}{5}$	$\frac{1}{8}$	$\frac{3}{4}$	$\frac{1}{10}$	$\frac{9}{10}$
$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{3}$	$\frac{5}{12}$	$\frac{1}{6}$	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{5}{6}$
$\frac{5}{16}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{7}{12}$	$\frac{1}{5}$	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{5}{6}$
$\frac{3}{8}$	$\frac{5}{9}$	$\frac{1}{10}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{4}{5}$	$\frac{1}{10}$	$\frac{3}{8}$	$\frac{2}{15}$	$\frac{7}{10}$
$\frac{3}{5}$	$\frac{7}{10}$	$\frac{5}{12}$	$\frac{3}{5}$	$\frac{2}{5}$	$\frac{4}{5}$	$\frac{1}{6}$	$\frac{5}{8}$	$\frac{11}{15}$	$\frac{5}{6}$
$\frac{3}{10}$	$\frac{2}{6}$	$\frac{1}{3}$	$\frac{9}{10}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{4}{9}$	$\frac{5}{6}$	$\frac{1}{10}$	$\frac{7}{15}$
$\frac{5}{8}$	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{4}{5}$	$\frac{1}{4}$	$\frac{2}{3}$	$\frac{5}{12}$	$\frac{5}{6}$	$\frac{8}{15}$	$\frac{9}{10}$
$\frac{3}{16}$	$\frac{7}{16}$	$\frac{2}{15}$	$\frac{8}{15}$	$\frac{3}{5}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{8}{9}$	$\frac{1}{6}$	$\frac{4}{15}$

Write 4 pairs of unlike fractions, each having a denominator than 12; then add the fractions of each pair.

PROBLEMS

The heavy lines show the streets along which these children walk to church, to school, and to the store.



1. How far must Jean walk to church?
2. How far must Mary walk to school?
3. How far is the church from the store?
4. How far is Paul's house from Jean's?
5. How far must John walk to the store? What directions must John walk in going from his home to the store? in returning home?
6. How far does Mary live from the store?
7. How far must Anna walk from her house to reach Mary's?
8. How far must Jean walk to school? How far must Paul walk to school? Anna? John?
9. In what directions must Paul walk in going to church? in returning home?
10. In what directions must Jean walk in going to Anna's house? in returning home?
11. Write five other questions that you can ask from this map and answer them.
12. Study the map and see who can ask the most questions from it.

Subtraction of Unlike Fractions. You have learned that unlike fractions must be reduced to similar fractions before you can add them. What must you do with unlike fractions before you can *subtract* one from the other?

Study how the differences in (1), (2), and (3) are found. Are the differences in lowest terms?

$$\begin{array}{r} (1) \\ \frac{9}{10} = \frac{9}{10} \\ \frac{2}{5} = \frac{4}{10} \\ \hline \text{Difference} = \frac{5}{10} = \frac{1}{2} \end{array}$$

$$\begin{array}{r} (2) \\ \frac{3}{4} = \frac{9}{12} \\ \frac{1}{3} = \frac{4}{12} \\ \hline \text{Difference} = \frac{5}{12} \end{array}$$

$$\begin{array}{r} (3) \\ \frac{7}{10} = \frac{21}{30} \\ \frac{1}{5} = \frac{6}{30} \\ \hline \text{Difference} = \frac{15}{30} = \frac{1}{2} \end{array}$$

SUBTRACTION OF UNLIKE FRACTIONS

Subtract, naming as many differences as you can at sight. The answers must contain no fractions not in lowest terms.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>
1.	$\frac{1}{3}$	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{7}{8}$	$\frac{7}{10}$	$\frac{1}{2}$	$\frac{15}{16}$	$\frac{3}{4}$	$\frac{7}{8}$
	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{2}{5}$	$\frac{5}{12}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{13}{16}$
2.	$\frac{5}{6}$	$\frac{2}{3}$	$\frac{5}{12}$	$\frac{5}{6}$	$\frac{11}{12}$	$\frac{7}{10}$	$\frac{1}{2}$	$\frac{11}{12}$	$\frac{3}{4}$	$\frac{5}{6}$
	$\frac{1}{2}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{3}$	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{3}{10}$	$\frac{2}{3}$	$\frac{5}{12}$	$\frac{7}{12}$
3.	$\frac{2}{3}$	$\frac{3}{5}$	$\frac{4}{5}$	$\frac{5}{8}$	$\frac{3}{5}$	$\frac{7}{8}$	$\frac{2}{5}$	$\frac{4}{5}$	$\frac{4}{5}$	$\frac{5}{6}$
	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{2}{3}$	$\frac{4}{5}$
4.	$\frac{1}{4}$	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{5}{8}$	$\frac{7}{8}$	$\frac{5}{6}$	$\frac{11}{12}$	$\frac{7}{12}$	$\frac{5}{8}$	$\frac{7}{8}$
	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{3}{8}$	$\frac{5}{8}$	$\frac{1}{8}$	$\frac{5}{12}$	$\frac{7}{12}$
5.	$\frac{3}{10}$	$\frac{1}{6}$	$\frac{9}{10}$	$\frac{9}{10}$	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{7}{15}$	$\frac{5}{6}$	$\frac{13}{15}$	$\frac{5}{6}$
	$\frac{1}{6}$	$\frac{1}{10}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{1}{10}$	$\frac{3}{10}$	$\frac{1}{6}$	$\frac{7}{10}$	$\frac{7}{10}$	$\frac{2}{15}$

6. Write six pairs of unlike fractions, each having a denominator less than 12, and subtract the fractions of each pair.

PROBLEMS

1. Ellen's mother told her that she could play for $\frac{3}{4}$ of an hour. After Ellen had played $\frac{1}{2}$ of an hour, how much longer had she to play?

2. John's father is given $\frac{3}{4}$ of an hour for lunch. If it requires $\frac{1}{8}$ of an hour for him to go from his place of employment and return, what part of an hour has he for his meal? How many minutes has he for his meal?

3. Sam walks to school in $\frac{1}{10}$ of an hour, but he leaves home for school half an hour before opening time so that he may have some time for play. What part of an hour has he to play? How many minutes has he for play?

4. Is $\frac{5}{8}$ of a yard of lace longer than $\frac{3}{4}$ of a yard or just as long or is it shorter? How can you tell? If there is a difference between these two lengths, how much difference?

5. The ice on our pond increased in thickness overnight from $\frac{1}{2}$ of an inch to $\frac{7}{8}$ of an inch. How much did it increase in thickness overnight?

6. Arrange these fractions in a column according to size, the least or smallest at the head of the column: $\frac{2}{3}$, $\frac{7}{12}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{1}{2}$, $\frac{5}{8}$.

7. Laura's mother bought $\frac{1}{2}$ doz. oranges at 40¢ a dozen. What did she pay for them? After she had used $\frac{1}{3}$ doz., what part of a dozen remained? How many remained?

8. Draw with your rule three lines, a , b , and c , making a $\frac{7}{8}$ in., b $\frac{3}{4}$ in., and c $\frac{1}{2}$ in. How much longer is a than b ? a than b than c ? Test your answers by measuring.

9. Make a list from the following fractions of those which are less than $\frac{3}{4}$ but greater than $\frac{1}{2}$: $\frac{3}{8}$, $\frac{2}{3}$, $\frac{2}{5}$, $\frac{3}{10}$, $\frac{9}{16}$, $\frac{4}{5}$, $\frac{7}{16}$, $\frac{3}{5}$, $\frac{5}{6}$.

10. Clara cut two pieces of lace each $\frac{1}{4}$ of a yard long from a piece $\frac{7}{8}$ of a yard long, what part of a yard did the piece remaining contain?

ADDING MIXED NUMBERS

Illustrative Problem. Marian bought two remnants of ribbon $2\frac{5}{8}$ yd. and $1\frac{7}{8}$ yd. Sara also bought two remnants of ribbon $2\frac{3}{4}$ yd. and $1\frac{1}{2}$ yd. Study how each girl found the number of yards of ribbon she bought.

$$\begin{array}{r} \text{MARIAN} \\ 2\frac{5}{8} \\ 1\frac{7}{8} \\ \hline \text{Sum} = 3\frac{12}{8} = 3\frac{3}{2} = 4\frac{1}{2} \end{array}$$

$$\begin{array}{r} \text{SARA} \\ 2\frac{3}{4} = 2\frac{3}{4} \\ 1\frac{1}{2} = 1\frac{2}{4} \\ \hline \text{Sum} = 3\frac{5}{4} = 4\frac{1}{4} \end{array}$$

Add, finding the sums at sight when you can. The fractions in the sums must be in lowest terms.

	2.	3.	4.	5.	6.	7.	8.
$2\frac{1}{2}$	$2\frac{3}{4}$	$3\frac{4}{5}$	$3\frac{1}{4}$	$5\frac{5}{6}$	$3\frac{1}{3}$	$5\frac{2}{3}$	$4\frac{5}{6}$
$1\frac{1}{2}$	$3\frac{1}{4}$	$1\frac{2}{5}$	$2\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{4}$	$6\frac{1}{2}$	$2\frac{1}{4}$
	10.	11.	12.	13.	14.	15.	16.
$2\frac{1}{2}$	$4\frac{3}{4}$	$3\frac{7}{12}$	$4\frac{5}{12}$	$6\frac{2}{3}$	$4\frac{7}{10}$	$2\frac{7}{12}$	$2\frac{3}{5}$
$3\frac{2}{3}$	$4\frac{7}{16}$	$6\frac{2}{3}$	$2\frac{3}{4}$	$5\frac{5}{9}$	$3\frac{4}{5}$	$3\frac{3}{4}$	$5\frac{9}{10}$

17. Here is the record of the number of hours Robert worked during four weeks of his vacation; fill in the totals. (Add down; add across.)

	MON.	TUES.	WED.	THURS.	FRI.	SAT.	TOTAL
1st week	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$2\frac{1}{2}$	4	
2d week	$1\frac{1}{4}$	$2\frac{3}{4}$	2	$2\frac{1}{2}$	$1\frac{1}{2}$	4	
3d week	$2\frac{3}{4}$	2	3	$3\frac{1}{4}$	$2\frac{3}{4}$	4	
4th week	$1\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{3}{4}$	$2\frac{1}{2}$	$1\frac{1}{2}$	4	
Total							

18. What did Robert earn in the four weeks at \$0.20 an hour?

SUBTRACTION INVOLVING MIXED NUMBERS

Illustrative Problems. 1. James weighed $60\frac{1}{2}$ lb. with his overcoat on and 57 lb. without it. Then he found the number pounds in the weight of the coat by thinking:

$$60\frac{1}{2} - 57 = 3\frac{1}{2} \text{ Ans.} \quad \text{or,} \quad \begin{array}{r} 60\frac{1}{2} \\ - 57 \\ \hline 3\frac{1}{2} \text{ Ans.} \end{array}$$

2. Margaret's mother had three pieces of gingham of 8 yd. $4\frac{1}{2}$ yd., and $5\frac{1}{4}$ yd. Margaret found the number of yards in the pieces remaining after $3\frac{1}{2}$ yd. of the first piece had been used, $\frac{3}{4}$ yd. of the second, and $3\frac{5}{8}$ yd. of the third. Study in (1), (2) and (3) how Margaret found her answers, and check them.

(1)

$$8 = 7\frac{1}{2}$$

$$3\frac{1}{2} = 3\frac{1}{2}$$

$$\text{Difference} = 4\frac{1}{2}$$

(2)

$$4\frac{1}{2} = 4\frac{1}{2} = 3\frac{3}{4}$$

$$\frac{3}{4} = \frac{3}{4}$$

$$\text{Difference} = 3\frac{3}{4}$$

(3)

$$5\frac{1}{4} = 5\frac{2}{8} = 4\frac{6}{8}$$

$$3\frac{5}{8} = 3\frac{5}{8}$$

$$\text{Difference} = 1\frac{1}{8}$$

NOTE. In examples like (1) try to subtract at sight.

1. Subtract at sight:

$7\frac{1}{2}$	$8\frac{1}{3}$	$9\frac{3}{5}$	$10\frac{2}{3}$	$12\frac{1}{2}$	$37\frac{1}{2}$	$14\frac{2}{7}$	$62\frac{1}{2}$	8
<u>5</u>	<u>2</u>	<u>4</u>	<u>6</u>	<u>5</u>	<u>10</u>	<u>12</u>	<u>50</u>	<u>7</u>

2. Write nine examples like those in 1 and subtract.

Subtract; reduce the fractions in the answers to lowest terms. Name as many answers as you can at sight. Check results.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
3.	$3\frac{1}{2}$	$4\frac{5}{8}$	$7\frac{5}{6}$	$5\frac{3}{4}$	$7\frac{5}{6}$	$8\frac{2}{3}$	$8\frac{7}{8}$	7
	<u>$\frac{1}{2}$</u>	<u>$\frac{1}{8}$</u>	<u>$\frac{1}{6}$</u>	<u>$\frac{1}{2}$</u>	<u>$\frac{1}{3}$</u>	<u>$1\frac{1}{3}$</u>	<u>$2\frac{1}{4}$</u>	<u>2</u>
4.	7	8	$12\frac{1}{2}$	$8\frac{1}{2}$	$7\frac{1}{2}$	$8\frac{1}{3}$	$7\frac{1}{2}$	9
	<u>$4\frac{1}{2}$</u>	<u>$6\frac{2}{3}$</u>	<u>$\frac{3}{4}$</u>	<u>$\frac{2}{3}$</u>	<u>$2\frac{3}{4}$</u>	<u>$1\frac{5}{6}$</u>	<u>$2\frac{2}{3}$</u>	<u>2</u>

PROBLEMS

1. If Richard buys papers at $1\frac{1}{5}\text{¢}$ each and sells them at 2¢ each, how much does he gain on each paper?
2. A telegraph pole 55 ft. long was set $7\frac{1}{2}$ ft. in the ground. How many feet of it were above ground?
3. What is the weight of the lard in a can if the lard and can weigh 22 lb. and the can weighs $3\frac{1}{2}$ lb.?
4. Roland cut a piece $1\frac{1}{2}$ ft. long from each end of a 12-foot piece of wire. How long was the piece that remained?
5. Madge made $2\frac{1}{2}$ lb. of chocolate fudge to sell at a children's fair, May made $3\frac{1}{2}$ lb. of vanilla fudge, and Grace made $1\frac{1}{2}$ lb. of peanut brittle. How many pounds of candy did they make for the fair? If each had $\frac{1}{2}$ lb. remaining, how many pounds did each sell?
6. John ran 100 yd. in 14 sec. and George ran the same distance in $13\frac{2}{5}$ sec. How much better was George's time than John's? What is the best time that you can make in a 100-yd. dash?
7. David's mother keeps a record of his weight and height. Here is part of the record. What was his increase in height between the ages of 9 yr. and 10 yr.? 10 yr. and 11 yr.? 11 yr. and 12 yr.? 12 yr. and 13 yr.? 9 yr. and 11 yr.? Answer the same questions about his increase in weight. Ask and answer five more questions from this table, each about David's increase in height or weight.
8. One day a river rose to $7\frac{1}{2}$ ft. above low water mark and the next day it fell $2\frac{3}{4}$ ft.; how high was it then above low water mark?

AGE (Years)	HEIGHT (Inches)	WEIGHT (Pounds)
9	$49\frac{1}{2}$	58
10	$51\frac{1}{4}$	$65\frac{1}{2}$
11	$53\frac{1}{8}$	$71\frac{3}{4}$
12	55	$79\frac{1}{4}$
13	$57\frac{1}{8}$	90

ACCURACY AND SPEED TESTS

Try to get the answers for each test in 2 minutes. All fractions in the results must be in lowest terms.

ADDITION

Test 1

$$\begin{array}{r} \frac{1}{8} \\ \frac{1}{8} \\ \hline \end{array} \quad \begin{array}{r} \frac{5}{12} \\ \frac{1}{12} \\ \hline \end{array} \quad \begin{array}{r} \frac{5}{16} \\ \frac{1}{16} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{10} \\ \frac{1}{10} \\ \hline \end{array}$$

Test 2

$$\begin{array}{r} \frac{1}{2} \\ \frac{1}{6} \\ \hline \end{array} \quad \begin{array}{r} \frac{2}{5} \\ \frac{1}{10} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{4} \\ \frac{1}{12} \\ \hline \end{array}$$

Test 3

$$\begin{array}{r} \frac{3}{4} \\ \frac{5}{12} \\ \hline \end{array} \quad \begin{array}{r} \frac{5}{6} \\ \frac{2}{3} \\ \hline \end{array} \quad \begin{array}{r} \frac{2}{3} \\ \frac{1}{12} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{5} \\ \frac{11}{15} \\ \hline \end{array}$$

Test 4

$$\begin{array}{r} \frac{2}{3} \\ \frac{4}{5} \\ \hline \end{array} \quad \begin{array}{r} \frac{7}{9} \\ \frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{4} \\ \frac{3}{5} \\ \hline \end{array}$$

Test 5

$$\begin{array}{r} \frac{1}{6} \\ \frac{1}{8} \\ \hline \end{array} \quad \begin{array}{r} \frac{1}{9} \\ \frac{5}{6} \\ \hline \end{array} \quad \begin{array}{r} \frac{1}{6} \\ \frac{5}{8} \\ \hline \end{array} \quad \begin{array}{r} \frac{1}{4} \\ \frac{1}{10} \\ \hline \end{array}$$

Test 6

$$\begin{array}{r} 1\frac{1}{9} \\ 2\frac{2}{9} \\ \hline \end{array} \quad \begin{array}{r} 2\frac{3}{4} \\ 3\frac{3}{4} \\ \hline \end{array} \quad \begin{array}{r} 4\frac{1}{2} \\ 1\frac{3}{10} \\ \hline \end{array}$$

Test 7

Count as quickly as you can to 60, counting thus: $2\frac{1}{2}$, 5, 7, 10, and so on.

Count this way: $12\frac{1}{2}$, 25, $37\frac{1}{2}$, and so on to 100.

Count this way: $6\frac{1}{4}$, $12\frac{1}{2}$, $18\frac{3}{4}$, and so on to 50.

SUBTRACTION

Test 1

$$\begin{array}{r} \frac{5}{6} \\ \frac{5}{6} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{8} \\ \frac{1}{8} \\ \hline \end{array} \quad \begin{array}{r} \frac{8}{9} \\ \frac{2}{9} \\ \hline \end{array} \quad \begin{array}{r} \frac{7}{12} \\ \frac{1}{12} \\ \hline \end{array}$$

Test 2

$$\begin{array}{r} \frac{1}{2} \\ \frac{1}{5} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{4} \\ \frac{2}{5} \\ \hline \end{array} \quad \begin{array}{r} \frac{2}{3} \\ \frac{2}{5} \\ \hline \end{array}$$

Test 3

$$\begin{array}{r} \frac{7}{12} \\ \frac{1}{4} \\ \hline \end{array} \quad \begin{array}{r} \frac{7}{10} \\ \frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} \frac{9}{10} \\ \frac{2}{5} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{4} \\ \frac{7}{12} \\ \hline \end{array}$$

Test 4

$$\begin{array}{r} \frac{9}{10} \\ \frac{3}{4} \\ \hline \end{array} \quad \begin{array}{r} \frac{5}{6} \\ \frac{3}{4} \\ \hline \end{array} \quad \begin{array}{r} \frac{5}{6} \\ \frac{5}{8} \\ \hline \end{array}$$

Test 5

$$\begin{array}{r} 6\frac{1}{2} \\ 2 \\ \hline \end{array} \quad \begin{array}{r} 8\frac{1}{3} \\ 3 \\ \hline \end{array} \quad \begin{array}{r} 4\frac{3}{5} \\ 1\frac{1}{5} \\ \hline \end{array} \quad \begin{array}{r} 5\frac{3}{8} \\ 1\frac{1}{8} \\ \hline \end{array}$$

Test 6

$$\begin{array}{r} 7\frac{2}{3} \\ 1\frac{1}{6} \\ \hline \end{array} \quad \begin{array}{r} 6 \\ 2\frac{5}{8} \\ \hline \end{array} \quad \begin{array}{r} 4\frac{1}{4} \\ \frac{3}{8} \\ \hline \end{array}$$

REVIEW

1. Nora's monthly dues in her Christmas Savings Club are \$1.00. She has 3 quarter dollars. How much more does she need to pay her monthly dues?
2. Vincent sold 3 pk. of early beans from his garden at 15¢ a quarter peck. How much did he receive for them?
3. Blanche exchanged 5 half dollars and 6 quarter dollars for dollar bills. How many dollar bills did she receive?
4. How far is the top of a picture from the floor if it is $2\frac{1}{2}$ ft. from the ceiling and the room is 9 ft. high?
5. Bertha requires $1\frac{1}{4}$ hr. to go from her home to the city by trolley. When should she reach the city if she leaves home at 10:00 A.M.? How long should it require her to go and return?
6. Some school girls had a May Day picnic. Edna, Dorothy, and Frances brought the butter to make sandwiches for the lunch. Edna brought $\frac{1}{2}$ lb., Dorothy $\frac{1}{4}$ lb., and Frances $\frac{1}{4}$ lb. How much butter did they all bring?
7. How many feet of wire must Edward have to inclose his garden, which is 30 ft. long and $16\frac{1}{2}$ ft. wide, making no allowance for waste and deducting $2\frac{1}{2}$ ft. for an entrance?

Multiplying a Fraction by a Whole Number.

$$(1) 2 \times \frac{2}{5} = \frac{2}{5} + \frac{2}{5} = \frac{4}{5}$$

$$(2) 2 \times \frac{3}{8} = \frac{3}{8} + \frac{3}{8} = \frac{6}{8} = \frac{3}{4}$$

Notice that the result in (1), that is, $\frac{4}{5}$, may be found directly by multiplying the numerator of $\frac{2}{5}$ by 2; and that the result in (2), that is, $\frac{3}{4}$, may be found directly by dividing the denominator $\frac{3}{8}$ by 2.

To multiply a fraction by a whole number, multiply the numerator or divide the denominator by the whole number. Divide the denominator when possible.

DRILL EXERCISE

Name at sight the products; the results should contain no improper fractions:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1. $2 \times \frac{1}{2}$	$3 \times \frac{2}{3}$	$4 \times \frac{3}{4}$	$5 \times \frac{4}{5}$	$6 \times \frac{5}{6}$
2. $2 \times \frac{1}{3}$	$3 \times \frac{1}{5}$	$5 \times \frac{1}{6}$	$3 \times \frac{1}{8}$	$5 \times \frac{1}{10}$
3. $2 \times \frac{2}{3}$	$3 \times \frac{2}{5}$	$3 \times \frac{2}{7}$	$2 \times \frac{4}{9}$	$3 \times \frac{1}{10}$
4. $2 \times \frac{3}{8}$	$3 \times \frac{2}{9}$	$4 \times \frac{1}{12}$	$5 \times \frac{3}{10}$	$4 \times \frac{1}{15}$
5. $4 \times \frac{1}{8}$	$5 \times \frac{2}{5}$	$4 \times \frac{3}{8}$	$6 \times \frac{5}{12}$	$2 \times \frac{1}{10}$
6. $6 \times \frac{5}{6}$	$5 \times \frac{3}{5}$	$7 \times \frac{3}{7}$	$5 \times \frac{7}{10}$	$8 \times \frac{1}{10}$
7. $7 \times \frac{3}{14}$	$9 \times \frac{5}{18}$	$8 \times \frac{7}{24}$	$10 \times \frac{3}{10}$	$10 \times \frac{1}{10}$
8. $6 \times \frac{7}{12}$	$7 \times \frac{5}{14}$	$8 \times \frac{5}{16}$	$10 \times \frac{1}{10}$	$10 \times \frac{1}{10}$

9. Write five examples like the above and multiply.

Cancellation. In the example $8 \times \frac{5}{6}$, what factor is there which is common to the whole number 8 and the denominator of the fraction $\frac{5}{6}$? Instead of writing:

$$8 \times \frac{5}{6} = \frac{40}{6} = \frac{20}{3} = 6\frac{2}{3},$$

we should write

$$\overset{4}{\cancel{8}} \times \frac{5}{\underset{3}{\cancel{6}}} = \frac{20}{3} = 6\frac{2}{3}.$$

Here we say we have *canceled* the like factor, 2, from both 8 and 6.

In multiplying a fraction by a whole number, before multiplying cancel the common factor, if there is one, from the whole number and the denominator of the fraction.

DRILL IN CANCELLATION

Using cancellation, find :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1.	$4 \times \frac{5}{8}$	$6 \times \frac{2}{9}$	$9 \times \frac{5}{8}$	$10 \times \frac{5}{12}$	$6 \times \frac{2}{15}$
2.	$6 \times \frac{7}{15}$	$8 \times \frac{7}{12}$	$8 \times \frac{5}{12}$	$9 \times \frac{11}{12}$	$10 \times \frac{3}{18}$
3.	$12 \times \frac{5}{18}$	$9 \times \frac{5}{12}$	$9 \times \frac{7}{12}$	$9 \times \frac{2}{15}$	$9 \times \frac{7}{15}$
4.	$12 \times \frac{5}{8}$	$12 \times \frac{7}{10}$	$12 \times \frac{3}{16}$	$12 \times \frac{7}{16}$	$10 \times \frac{9}{10}$
5.	$15 \times \frac{3}{10}$	$15 \times \frac{9}{10}$	$16 \times \frac{5}{12}$	$16 \times \frac{7}{12}$	$16 \times \frac{1}{14}$
6.	$16 \times \frac{7}{10}$	$16 \times \frac{9}{10}$	$18 \times \frac{3}{4}$	$18 \times \frac{5}{8}$	$20 \times \frac{5}{12}$
7.	$20 \times \frac{3}{8}$	$20 \times \frac{7}{8}$	$20 \times \frac{1}{12}$	$24 \times \frac{5}{16}$	$24 \times \frac{7}{16}$
8.	$20 \times \frac{5}{8}$	$24 \times \frac{9}{16}$	$24 \times \frac{11}{16}$	$24 \times \frac{15}{16}$	$25 \times \frac{7}{10}$
9.	$25 \times \frac{3}{10}$	$25 \times \frac{9}{10}$	$32 \times \frac{7}{12}$	$30 \times \frac{5}{12}$	$36 \times \frac{5}{24}$

PROBLEMS

1. Nora's music lesson lasts $\frac{1}{2}$ hr. She takes 2 lessons a week. How much time do her music lessons require each week? How much do they cost her father per week at the rate of \$1.50 a lesson?
2. Nora's older sister goes to school and recites five $\frac{3}{4}$ -hour periods a day. How many hours does she recite in a day?
3. Eight $\frac{5}{8}$ -bushel baskets of potatoes were sold at \$2 a bushel. How many bushels were sold and what was received for them?
4. George's father sold sixteen $\frac{5}{8}$ -bushel baskets of peaches at \$3.20 a bushel. How many bushels did he sell? What did he receive for them?
5. How many yards of toweling are required for 6 towels, if $\frac{3}{4}$ of a yard is used in making each towel? How many yards are required for a dozen such towels? for 8? for 9?
6. What is the cost of 100 ft. of wire at $\frac{3}{4}$ ¢ a foot?

7. How many yards of goods are needed to make 2 pairs of sash curtains, if each curtain requires $\frac{3}{4}$ of a yard?
8. Elsie made 2 pairs of sash curtains for her room. She used $\frac{7}{8}$ yd. of scrim for each curtain. How many yards did she use for the two pairs?
9. Mark makes a profit of $\frac{4}{5}\text{¢}$ on each copy of the newspapers which he sells. What is his profit on a sale of 50? 60? 55? 75?

Multiplying a Mixed Number by a Whole Number.

$$2 \times 2\frac{1}{3} = ?$$

$$2 \times 2 = 4$$

$$2 \times \frac{1}{3} = \frac{2}{3}$$

Adding 4 and $\frac{2}{3}$, we have $4\frac{2}{3}$, the product.

To multiply a mixed number by a whole number, multiply the whole number and the fractional part separately and add the products.

NOTE. Another way of finding the product of a mixed number multiplied by a whole number is to reduce the mixed number to an improper fraction and multiply as on page 66.

MULTIPLYING A MIXED NUMBER BY A WHOLE NUMBER

Multiply at sight. Remember that multiplying the numerator or dividing the denominator multiplies the fraction.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1. $2 \times 1\frac{1}{2}$	$3 \times 1\frac{1}{3}$	$4 \times 1\frac{1}{4}$	$5 \times 1\frac{1}{5}$	$6 \times 1\frac{1}{6}$
2. $2 \times 2\frac{1}{2}$	$3 \times 2\frac{1}{2}$	$4 \times 2\frac{1}{2}$	$5 \times 2\frac{1}{2}$	$6 \times 2\frac{1}{2}$
3. $2 \times 2\frac{2}{5}$	$2 \times 2\frac{2}{9}$	$3 \times 2\frac{1}{3}$	$3 \times 3\frac{2}{9}$	$4 \times 2\frac{2}{9}$
4. $2 \times 3\frac{1}{8}$	$3 \times 2\frac{2}{9}$	$4 \times 2\frac{3}{8}$	$5 \times 1\frac{1}{10}$	$4 \times 2\frac{1}{10}$
5. $2 \times 4\frac{3}{4}$	$3 \times 3\frac{5}{8}$	$4 \times 5\frac{5}{12}$	$6 \times 2\frac{7}{12}$	$8 \times 3\frac{1}{12}$
6. $4 \times 2\frac{5}{8}$	$6 \times 3\frac{5}{8}$	$6 \times 3\frac{7}{8}$	$8 \times 2\frac{5}{12}$	$9 \times 4\frac{5}{8}$

7. Mary's mother bought $3\frac{3}{4}$ yd. of goods for each of the four school dresses which she is making for Mary. How many yards of goods did she buy? How many yards do two of Mary's dresses require? three of them?

8. James measured his room to find out how much molding he would need to buy for it. He found that it would require two pieces each $14\frac{1}{2}$ ft. long and two pieces each $16\frac{2}{3}$ ft. long. How much molding was required?

9. There are $5\frac{1}{2}$ yd. in a rod and 3 ft. in a yard; how many feet are there in 1 rd.?

10. There are $16\frac{1}{2}$ ft. in a rod and 320 rd. in a mile; how many feet are there in 1 mi.?

MULTIPLYING A WHOLE NUMBER BY A FRACTION

Such an expression as $\frac{3}{4}$ of is frequently written $\frac{3}{4} \times$, but $\frac{3}{4} \times$ should be read $\frac{3}{4}$ of.

1. Find $\frac{1}{2} \times 5$.

Think $\frac{5}{2}$ (since $\frac{1}{2}$ of 5 means $5 \div 2$), and change $\frac{5}{2}$ to $2\frac{1}{2}$.

Name at sight the products:

2. $\frac{1}{2} \times 3$ $\frac{1}{2} \times 7$ $\frac{1}{2} \times 9$ $\frac{1}{3} \times 4$ $\frac{1}{3} \times 5$ $\frac{1}{4} \times 5$ $\frac{1}{4} \times 7$ $\frac{1}{4} \times 9$

3. $\frac{1}{3} \times 2$ $\frac{1}{4} \times 2$ $\frac{1}{5} \times 2$ $\frac{1}{5} \times 3$ $\frac{1}{5} \times 8$ $\frac{1}{5} \times 9$ $\frac{1}{6} \times 5$ $\frac{1}{6} \times 7$

4. $\frac{1}{2}$ of 11 $\frac{1}{2}$ of 15 $\frac{1}{3}$ of 16 $\frac{1}{3}$ of 20 $\frac{1}{3}$ of 25 $\frac{1}{4}$ of 15 $\frac{1}{4}$ of 25 $\frac{1}{4}$ of 50

5. Find $\frac{3}{4} \times 8$.

Think $3 \times \frac{1}{4}$ of 8, or 6. (Notice that 8 is divisible by 4.)

Name at sight the products:

6. $\frac{2}{3}$ of 6 $\frac{2}{3}$ of 9 $\frac{3}{4}$ of 8 $\frac{3}{4}$ of 12 $\frac{3}{4}$ of 16 $\frac{3}{4}$ of 20 $\frac{2}{5}$ of 10

7. $\frac{3}{5}$ of 10 $\frac{4}{5}$ of 15 $\frac{5}{6}$ of 12 $\frac{5}{6}$ of 18 $\frac{2}{7}$ of 14 $\frac{3}{7}$ of 21 $\frac{3}{8}$ of 16

8. Find $\frac{3}{4} \times 6$.

Thus:

$$\frac{3}{4} \times 6 = \frac{3}{4} \times \frac{6}{1} = \frac{3}{4} \times \frac{3}{1} \times \frac{2}{2} = \frac{9}{2} = 4\frac{1}{2}.$$

For, $\frac{3}{4}$ of 1 = $\frac{3}{4}$; therefore, $\frac{3}{4}$ of 6 = $6 \times \frac{3}{4} = \frac{3}{4} \times \frac{6}{1} = \frac{3}{4} \times \frac{3}{1} \times \frac{2}{2} = \frac{9}{2} = 4\frac{1}{2}$.

Find the products:

$$\begin{array}{cccccccc} 9. & \frac{5}{6} \times 8 & \frac{3}{4} \times 10 & \frac{5}{12} \times 8 & \frac{5}{12} \times 10 & \frac{7}{12} \times 8 & \frac{3}{16} \times 12 & \frac{5}{16} \times 10 \\ & \frac{1}{12} \times 10 & \frac{5}{16} \times 12 & \frac{7}{16} \times 24 & \frac{3}{10} \times 15 & \frac{7}{10} \times 25 & \frac{9}{10} \times 25 & \frac{11}{12} \times 16 \end{array}$$

10. Find $\frac{3}{4} \times 5$.

Think $\frac{3}{4} \times 5 = \frac{15}{4} = 3\frac{3}{4}$.

For, $\frac{3}{4}$ of 1 = $\frac{3}{4}$; therefore, $\frac{3}{4}$ of 5 = $5 \times \frac{3}{4}$, or $\frac{15}{4}$ or $3\frac{3}{4}$.

$$\begin{array}{cccccccc} 11. & \frac{2}{3} \times 4 & \frac{2}{3} \times 5 & \frac{3}{4} \times 9 & \frac{3}{4} \times 7 & \frac{3}{4} \times 11 & \frac{5}{6} \times 7 & \frac{3}{5} \times 8 \\ 12. & \frac{3}{4} \times 15 & \frac{3}{4} \times 21 & \frac{8}{3} \times 25 & \frac{2}{3} \times 28 & \frac{4}{5} \times 24 & \frac{3}{10} \times 21 & \frac{7}{10} \times 27 \end{array}$$

PROBLEMS

1. Edith's mother used 1 doz. boxes of cereal in 4 weeks. What part of a dozen boxes did she use each week? How many boxes did she use?

2. Alice bought 2 lb. of candy and put it up in four boxes the same amount in each. How much did each box contain?

3. In sponging a piece of cloth containing 5 yd., the tailor found that it shrank $\frac{1}{10}$ of its length. What was its length after being sponged?

4. How many days are there in $\frac{1}{2}$ of a week?

5. How many days are there in $\frac{1}{2}$ of December?

6. Draw a line exactly 7 in. long and divide it into 4 equal parts. How long is one of these parts? How long are 3 of them?

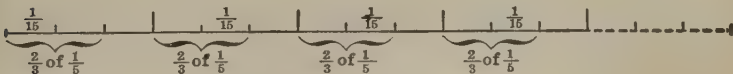
7. How long is each side of a square if the distance around it is 9 in.?

Find the cost of:

8. $\frac{1}{2}$ doz. eggs at 70¢ a dozen; at 64¢ a dozen.
9. $\frac{1}{4}$ lb. of boiled ham at 80¢ a pound; $\frac{3}{4}$ lb.
10. $\frac{1}{4}$ lb. of bacon at 36¢ a pound; $\frac{3}{4}$ lb.
11. $\frac{1}{2}$ doz. oranges at 60¢ a dozen; $\frac{5}{6}$ doz.
12. $\frac{1}{2}$ lb. of butter at 54¢ a pound; at 48¢ a pound.
13. $\frac{1}{4}$ doz. paint brushes at \$2 a dozen; $\frac{3}{4}$ doz.
14. $\frac{3}{4}$ pk. of new potatoes at 40¢ a peck.
15. Bettie's mother told her to make 8 towels out of 6 yd. of goods. What part of a yard does that allow for each towel?

Finding the Product of Two Fractions.

Here we see that $\frac{2}{3}$ of $\frac{4}{5} = \frac{8}{15}$, which is equal to $\frac{2 \times 4}{3 \times 5}$.



NOTE. $\frac{2}{3}$ of $\frac{4}{5}$ and $\frac{2}{3} \times \frac{4}{5}$ have the same meaning.

The product of two fractions equals the product of their numerators divided by the product of their denominators.

FINDING THE PRODUCT OF TWO FRACTIONS

1. Multiply $\frac{25}{6}$ by $\frac{9}{10}$.

This shows the different steps:

$$\frac{9}{10} \times \frac{25}{6} = \frac{\overset{3}{\cancel{9}} \times \overset{5}{\cancel{25}}}{\underset{2}{\cancel{10}} \times \underset{2}{\cancel{6}}} = \frac{15}{4} = 3\frac{3}{4}$$

In practice write only this:

$$\frac{9}{10} \times \frac{25}{6} = \frac{15}{4} = 3\frac{3}{4}$$

We divide 9 and 6 by 3, and 25 and 10 by 5, and *cancel* the numbers divided. This reduces the product to lowest terms.

Multiply; cancel when you can:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
2.	$\frac{1}{2} \times \frac{2}{3}$	$\frac{1}{3} \times \frac{3}{4}$	$\frac{4}{5} \times \frac{1}{4}$	$\frac{3}{5} \times \frac{1}{3}$	$\frac{5}{8} \times \frac{1}{5}$
3.	$\frac{4}{3} \times \frac{3}{2}$	$\frac{6}{5} \times \frac{5}{3}$	$\frac{4}{3} \times \frac{9}{4}$	$\frac{3}{5} \times \frac{10}{3}$	$\frac{5}{8} \times \frac{12}{5}$
4.	$\frac{2}{3} \times \frac{3}{5}$	$\frac{3}{4} \times \frac{4}{5}$	$\frac{3}{5} \times \frac{5}{7}$	$\frac{7}{8} \times \frac{8}{9}$	$\frac{3}{10} \times \frac{10}{7}$
5.	$\frac{2}{3} \times \frac{3}{4}$	$\frac{2}{5} \times \frac{5}{6}$	$\frac{4}{9} \times \frac{3}{4}$	$\frac{4}{15} \times \frac{3}{4}$	$\frac{5}{8} \times \frac{2}{5}$
6.	$\frac{9}{8} \times \frac{8}{3}$	$\frac{3}{5} \times \frac{9}{10}$	$\frac{3}{4} \times \frac{8}{9}$	$\frac{5}{4} \times \frac{8}{15}$	$\frac{5}{6} \times \frac{12}{25}$
7.	$\frac{2}{3} \times \frac{9}{4}$	$\frac{3}{4} \times \frac{16}{9}$	$\frac{4}{5} \times \frac{15}{8}$	$\frac{9}{10} \times \frac{5}{3}$	$\frac{25}{6} \times \frac{2}{5}$
8.	$\frac{10}{9} \times \frac{6}{5}$	$\frac{8}{9} \times \frac{15}{4}$	$\frac{10}{9} \times \frac{12}{5}$	$\frac{9}{8} \times \frac{10}{3}$	$\frac{10}{3} \times \frac{9}{16}$
9.	$\frac{2}{9} \times \frac{6}{5}$	$\frac{3}{8} \times \frac{6}{5}$	$\frac{12}{5} \times \frac{2}{9}$	$\frac{5}{4} \times \frac{15}{4}$	$\frac{7}{6} \times \frac{3}{10}$
10.	$\frac{12}{25} \times \frac{10}{9}$	$\frac{8}{15} \times \frac{25}{6}$	$\frac{6}{15} \times \frac{25}{8}$	$\frac{8}{9} \times \frac{21}{20}$	$\frac{8}{9} \times \frac{15}{16}$
11.	$\frac{1}{2} \times \frac{1}{3}$	$\frac{1}{4} \times \frac{1}{3}$	$\frac{3}{5} \times \frac{1}{2}$	$\frac{1}{5} \times \frac{2}{3}$	$\frac{1}{5} \times \frac{3}{4}$
12.	$\frac{2}{3} \times \frac{2}{5}$	$\frac{2}{5} \times \frac{3}{4}$	$\frac{3}{4} \times \frac{5}{2}$	$\frac{3}{2} \times \frac{5}{8}$	$\frac{3}{5} \times \frac{3}{4}$

To multiply a mixed number by a fraction, first reduce the mixed number to a fraction. Thus, $\frac{2}{3} \times 1\frac{1}{2} = \frac{2}{3} \times \frac{3}{2} = ?$

13.	$\frac{2}{3} \times 1\frac{1}{4}$	$\frac{3}{4} \times 2\frac{2}{3}$	$\frac{5}{6} \times 1\frac{1}{2}$	$\frac{4}{5} \times 3\frac{1}{3}$	$\frac{3}{5} \times 6\frac{2}{3}$
14.	$\frac{2}{5} \times 2\frac{2}{3}$	$\frac{3}{4} \times 1\frac{7}{8}$	$\frac{2}{9} \times 3\frac{3}{8}$	$\frac{3}{7} \times 3\frac{8}{9}$	$\frac{4}{5} \times 16\frac{1}{5}$
15.	$\frac{3}{8} \times 2\frac{2}{3}$	$\frac{4}{5} \times 7\frac{1}{2}$	$\frac{4}{5} \times 12\frac{1}{2}$	$\frac{3}{8} \times 33\frac{1}{3}$	$\frac{2}{5} \times 14\frac{1}{2}$

PROBLEMS

- Find the cost of $\frac{3}{4}$ lb. of cheese at 24¢ a pound.
- What is the distance around a square that is $\frac{3}{8}$ of a foot long?
- There are $5\frac{1}{2}$ yd. in a rod. How many yards are there in $\frac{1}{2}$ rd.? in $\frac{3}{4}$ rd.? in $\frac{5}{8}$ rd.?
- What length of wire netting is required to inclose a poultry yard $33\frac{1}{2}$ ft. long and $16\frac{1}{2}$ ft. wide?
- What should be paid for 2 cords of wood at $\$7\frac{1}{2}$ a cord?

6. At the rate of 40 mi. per hour, how far will an automobile go from 2.30 P.M. to 3.45 P.M.?
7. Find the cost of $2\frac{1}{2}$ lb. of sirloin steak at \$0.50 per pound; $\frac{1}{2}$ lb.; $2\frac{1}{4}$ lb.
8. What is the cost of $1\frac{1}{2}$ doz. eggs at \$0.60 a dozen?
9. At the rate of $1\frac{2}{3}$ mi. per minute, how far does an airplane go in $\frac{1}{4}$ hr.?
10. How many yards of toweling are required to make 6 towels each $\frac{7}{8}$ yd. long? If they are cut from a remnant of toweling containing $5\frac{1}{2}$ yd., how much of the remnant will be left over?
11. What profit does a boy make on 120 newspapers if he buys them at $1\frac{2}{5}\text{¢}$ each and sells them at 2¢ each?
12. How many feet of molding are required for a room $22\frac{1}{2}$ ft. long and $22\frac{1}{2}$ ft. wide?
13. Will $9\frac{1}{4}$ yd. be enough for a dozen towels each containing $\frac{3}{4}$ yd.?
14. At \$0.90 an hour what will a carpenter earn in $4\frac{1}{2}$ hr.?
15. At \$1.10 an hour what will a plumber earn in $2\frac{1}{2}$ hr.?

Multiplying Integers, Fractions, or Mixed Numbers by a Mixed Number.

(1) When the multiplier, or the multiplier and the multiplicand both, are small mixed numbers, the product may be readily found; thus:

Multiply $2\frac{2}{5}$ by $2\frac{1}{4}$.

$$2\frac{1}{4} \times 2\frac{2}{5} = \frac{9}{4} \times \frac{12}{5} = \frac{27}{5} = 5\frac{2}{5}$$

DRILL

Multiply:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1. $1\frac{1}{2} \times \frac{2}{3}$	$1\frac{1}{4} \times \frac{4}{5}$	$1\frac{1}{3} \times \frac{3}{5}$	$1\frac{3}{4} \times \frac{8}{9}$	$1\frac{3}{4} \times \frac{2}{3}$
2. $1\frac{3}{5} \times \frac{5}{6}$	$2\frac{1}{2} \times \frac{4}{5}$	$1\frac{1}{2} \times 4$	$1\frac{1}{2} \times 5$	$2\frac{1}{2} \times 3$
3. $2\frac{1}{3} \times 3\frac{3}{4}$	$4\frac{1}{2} \times 2\frac{1}{3}$	$2\frac{1}{4} \times 3\frac{1}{3}$	$3\frac{3}{4} \times 4\frac{1}{4}$	$6\frac{2}{3} \times 4$
4. $7\frac{1}{2} \times 2\frac{2}{3}$	$8\frac{1}{3} \times 3\frac{2}{5}$	$4\frac{3}{4} \times 4\frac{3}{4}$	$7\frac{1}{2} \times 7\frac{1}{2}$	$7\frac{1}{2} \times 6$

(2) When the multiplier is a large mixed number and the multiplicand an integer or a mixed number, the product may be readily found:

(a) Multiply 254 by $23\frac{2}{3}$.

$$\begin{array}{r}
 254 \\
 23\frac{2}{3} \\
 \hline
 3 \overline{)508} \\
 169\frac{1}{3} = \frac{2}{3} \times 254 \\
 762 = 3 \times 254 \\
 508 = 20 \times 254 \\
 \hline
 6011\frac{1}{3} = 23\frac{2}{3} \times 254
 \end{array}$$

(b) Multiply $236\frac{1}{2}$ by $25\frac{2}{3}$.

$$\begin{array}{r}
 236\frac{1}{2} \\
 25\frac{2}{3} \\
 \hline
 \frac{1}{3} = \frac{1}{3} \times \frac{1}{2} \\
 157\frac{1}{3} = \frac{2}{3} \times 236 \\
 12\frac{1}{2} = 25 \times \frac{1}{2} \\
 1180 = 5 \times 236 \\
 472 = 20 \times 236 \\
 \hline
 6070\frac{1}{3} = 25\frac{2}{3} \times 236\frac{1}{2}
 \end{array}$$

REMARK. In practice omit the part shown to the right of the equal sign.

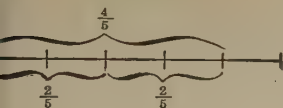
DRILL

Multiply:

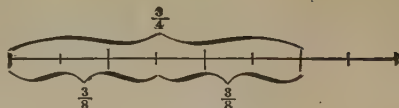
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	
1. 24	36	48	56	72
$12\frac{1}{2}$	$12\frac{2}{3}$	$23\frac{3}{4}$	$45\frac{7}{8}$	25
2. 32	42	64	75	96
$24\frac{1}{3}$	$26\frac{2}{3}$	$25\frac{4}{5}$	$38\frac{5}{6}$	48
3. $36\frac{1}{2}$	$64\frac{1}{3}$	$82\frac{1}{2}$	$48\frac{3}{4}$	54
$12\frac{1}{9}$	$26\frac{1}{2}$	$33\frac{1}{3}$	$56\frac{1}{2}$	36
4. $64\frac{2}{3}$	$56\frac{5}{6}$	$78\frac{3}{4}$	$66\frac{2}{3}$	84
$48\frac{3}{4}$	$54\frac{2}{3}$	$65\frac{2}{5}$	$65\frac{3}{4}$	72

Dividing a Fraction by a Whole Number.

Here we see that :



$$(1) \frac{4}{5} \div 2 = \frac{2}{5}.$$



$$(2) \frac{3}{4} \div 2 = \frac{3}{8}.$$

We also see that the result in (1), that is, $\frac{2}{5}$, may be found by dividing the numerator of $\frac{4}{5}$ by 2; and that the result in (2), that is, $\frac{3}{8}$, may be found by multiplying the denominator of $\frac{3}{4}$ by 2.

To divide a fraction by a whole number, divide the numerator or multiply the denominator by the whole number. Divide the numerator when possible.

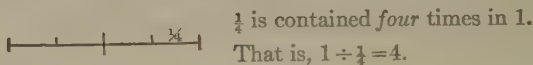
DIVIDING A FRACTION BY A WHOLE NUMBER

Find the quotients, naming as many as possible at sight :

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1. $\frac{2}{3} \div 2$	$\frac{2}{5} \div 2$	$\frac{6}{8} \div 2$	$\frac{5}{8} \div 5$	$\frac{6}{8} \div 3$
2. $\frac{10}{3} \div 5$	$\frac{9}{2} \div 3$	$\frac{8}{3} \div 4$	$\frac{9}{10} \div 3$	$\frac{9}{16} \div 3$
3. $\frac{1}{2} \div 2$	$\frac{1}{3} \div 2$	$\frac{1}{4} \div 2$	$\frac{1}{5} \div 2$	$\frac{1}{8} \div 2$
4. $\frac{2}{3} \div 3$	$\frac{1}{2} \div 3$	$\frac{1}{2} \div 5$	$\frac{5}{4} \div 2$	$\frac{4}{3} \div 3$
5. $\frac{3}{4} \div 5$	$\frac{5}{6} \div 3$	$\frac{3}{4} \div 3$	$\frac{4}{5} \div 3$	$\frac{3}{10} \div 2$
6. $\frac{9}{10} \div 6$	SOLUTION.	$\frac{9}{10} \div 6 = \frac{\overset{3}{9}}{10 \times \underset{2}{6}} = \frac{3}{20}.$		
7. $\frac{8}{5} \div 6$	$\frac{4}{3} \div 6$	$\frac{15}{8} \div 10$	$\frac{6}{8} \div 8$	$\frac{6}{7} \div 4$
8. $\frac{10}{9} \div 6$	$\frac{16}{9} \div 12$	$\frac{10}{3} \div 8$	$\frac{15}{16} \div 10$	$\frac{15}{8} \div 12$
9. $4\frac{2}{5} \div 2$	SUGGESTION. Divide the whole number, then the fraction, or reduce the mixed number to a fraction before dividing.			
10. $6\frac{3}{8} \div 2$	$8\frac{8}{9} \div 4$	$15\frac{3}{4} \div 3$	$18\frac{3}{4} \div 2$	$12\frac{2}{3} \div 3$
11. $1\frac{2}{3} \div 5$	$6\frac{2}{3} \div 5$	$7\frac{1}{2} \div 5$	$8\frac{1}{3} \div 5$	$16\frac{2}{3} \div 5$

Fractional Unit. A fraction whose numerator is 1 is called *fractional unit*; as, $\frac{1}{2}$ or $\frac{1}{3}$ or $\frac{1}{4}$.

Dividing 1 by a Fractional Unit. Study this figure to see that



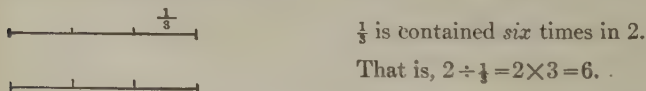
The quotient of 1 divided by a fractional unit is a number equal to the denominator of the fraction.

DIVIDING 1 BY A FRACTIONAL UNIT

Name at sight the quotient :

- | | | | | | |
|-------------------------|-----------------------|----------------------|-----------------------|-----------------------|-----------------------|
| 1. $1 \div \frac{1}{2}$ | $1 \div \frac{1}{3}$ | $1 \div \frac{1}{5}$ | $1 \div \frac{1}{8}$ | $1 \div \frac{1}{8}$ | $1 \div \frac{1}{10}$ |
| 2. $1 \div \frac{1}{4}$ | $1 \div \frac{1}{12}$ | $1 \div \frac{1}{9}$ | $1 \div \frac{1}{16}$ | $1 \div \frac{1}{15}$ | $1 \div \frac{1}{18}$ |

Dividing Any Integer by a Fractional Unit. Study the diagram to find how many thirds in 1 ; how many thirds in 2.



The quotient of any whole number divided by a fractional unit is the product of the denominator of the fractional unit and the whole number.

DIVIDING ANY INTEGER BY A FRACTIONAL UNIT

Name at sight the quotient :

- | | | | | | |
|-------------------------|-----------------------|-----------------------|----------------------|----------------------|-----------------------|
| 1. $2 \div \frac{1}{2}$ | $3 \div \frac{1}{2}$ | $2 \div \frac{1}{3}$ | $3 \div \frac{1}{4}$ | $2 \div \frac{1}{5}$ | $3 \div \frac{1}{6}$ |
| 2. $4 \div \frac{1}{2}$ | $5 \div \frac{1}{3}$ | $5 \div \frac{1}{2}$ | $5 \div \frac{1}{4}$ | $2 \div \frac{1}{8}$ | $4 \div \frac{1}{10}$ |
| 3. $3 \div \frac{1}{5}$ | $2 \div \frac{1}{10}$ | $3 \div \frac{1}{12}$ | $6 \div \frac{1}{2}$ | $8 \div \frac{1}{3}$ | $10 \div \frac{1}{4}$ |

4. Write twelve examples like the above and name the quotients at sight.

Inverting Fractions. When the terms of a fraction are interchanged, the fraction is said to be *inverted*.

$\frac{3}{4}$ inverted is $\frac{4}{3}$; or, $\frac{4}{3}$ is the inverse of $\frac{3}{4}$.

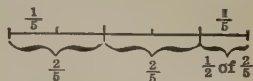
What is the inverse of $\frac{4}{5}$? $\frac{5}{6}$? $\frac{5}{3}$? $\frac{1}{2}$? $\frac{1}{3}$? $\frac{2}{3}$? 3 ($3 = \frac{3}{1}$)?

Dividing 1 by Any Fraction. From the figure it may be seen at:

1 contains 2 times $\frac{2}{5}$ plus $\frac{1}{2}$ of $\frac{2}{5}$.

That is, $1 \div \frac{2}{5} = 2\frac{1}{2}$.

The answer, $2\frac{1}{2}$, is equal to $\frac{5}{2}$, which is the *inverse* of the divisor $\frac{2}{5}$.



The quotient of 1 divided by a fraction is the inverse of the fraction.

DIVIDING 1 BY ANY FRACTION

Name at sight the quotient:

1. $1 \div \frac{2}{3}$	$1 \div \frac{3}{2}$	$1 \div \frac{3}{4}$	$1 \div \frac{4}{5}$	$1 \div \frac{5}{8}$	$1 \div \frac{5}{9}$
2. $1 \div \frac{5}{4}$	$1 \div \frac{8}{9}$	$1 \div \frac{7}{9}$	$1 \div \frac{7}{12}$	$1 \div \frac{3}{10}$	$1 \div \frac{5}{12}$
3. $1 \div \frac{7}{8}$	$1 \div \frac{10}{3}$	$1 \div \frac{7}{6}$	$1 \div \frac{5}{2}$	$1 \div \frac{9}{10}$	$1 \div \frac{3}{20}$

Dividing Any Integer by a Fraction.

Divide 2 by $\frac{2}{5}$.

$1 \div \frac{2}{5} = \frac{5}{2}$; therefore, $2 \div \frac{2}{5} = 2 \times \frac{5}{2}$, or 5.

To divide any integer by a fraction, invert the fraction and multiply.

DIVIDING ANY INTEGER BY A FRACTION

Name at sight the quotient:

1. $2 \div \frac{2}{3}$	$3 \div \frac{2}{3}$	$2 \div \frac{3}{4}$	$3 \div \frac{4}{5}$	$2 \div \frac{5}{8}$	$3 \div \frac{3}{2}$
2. $5 \div \frac{2}{3}$	$4 \div \frac{6}{5}$	$7 \div \frac{3}{2}$	$4 \div \frac{5}{4}$	$3 \div \frac{2}{9}$	$5 \div \frac{3}{10}$
3. $8 \div \frac{3}{4}$	$6 \div \frac{5}{2}$	$9 \div \frac{5}{4}$	$3 \div \frac{3}{8}$	$5 \div \frac{5}{6}$	$8 \div \frac{8}{9}$
4. $7 \div \frac{2}{3}$	$5 \div \frac{5}{4}$	$10 \div \frac{2}{5}$	$9 \div \frac{2}{3}$	$2 \div \frac{3}{8}$	$4 \div \frac{3}{10}$

Dividing a Fraction by a Fraction. We have already learned that:

$$2 \div \frac{2}{5} = 2 \times \frac{5}{2}$$

This shows that *any whole number* $\div \frac{2}{5}$ = that number $\times \frac{5}{2}$.

It is likewise true when we have *a fraction* instead of a whole number as the dividend, that:

$$\text{Any fraction} \div \frac{2}{5} = \text{that fraction} \times \frac{5}{2}.$$

For example, $\frac{3}{4} \div \frac{2}{5} = \frac{3}{4} \times \frac{5}{2}$

To divide a fraction by a fraction, multiply the dividend by the inverse of the divisor.

Always cancel when possible.

For example,
$$\frac{6}{5} \div \frac{9}{10} = \frac{6}{5} \times \frac{10}{9} = \frac{2}{3} \times \frac{2}{3} = 1\frac{1}{3}.$$

Dividing Any Number by a Fraction. Since a whole number may be regarded as a fraction whose denominator is 1 and a mixed number may be reduced to a fraction, we may say:

To divide any number by a fraction, multiply the number by the inverse of the fraction.

For example,

$$1. \quad 2 \div \frac{2}{3} = 2 \times \frac{3}{2} = 1^0 = 3\frac{1}{2}.$$

$$2. \quad 3\frac{1}{2} \div 1\frac{1}{4} = \frac{10}{3} \div \frac{5}{4} = \frac{10}{3} \times \frac{4}{5} = \frac{8}{3} = 2\frac{2}{3}.$$

DIVIDING A FRACTION BY A FRACTION

Divide the following:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
1. $\frac{1}{4} \div \frac{1}{2}$	$\frac{2}{3} \div \frac{4}{5}$	$\frac{1}{2} \div \frac{1}{3}$	$\frac{5}{8} \div \frac{9}{10}$	$\frac{1}{6} \div \frac{1}{3}$	$\frac{4}{5} \div \frac{2}{3}$
2. $\frac{1}{3} \div \frac{3}{4}$	$\frac{7}{8} \div \frac{7}{8}$	$\frac{3}{4} \div \frac{1}{8}$	$\frac{5}{12} \div \frac{3}{4}$	$\frac{3}{4} \div \frac{1}{3}$	$\frac{3}{4} \div \frac{7}{8}$

DRILL

Divide the following; cancel when you can:

*a**b**c**d*

1. $\frac{1}{2} \div \frac{1}{4}$

$\frac{1}{3} \div \frac{1}{2}$

$\frac{1}{3} \div \frac{1}{5}$

$\frac{1}{4} \div \frac{1}{2}$

2. $\frac{2}{3} \div \frac{1}{3}$

$\frac{1}{4} \div \frac{3}{4}$

$\frac{1}{2} \div \frac{4}{5}$

$\frac{3}{5} \div \frac{1}{10}$

3. $\frac{2}{5} \div \frac{3}{10}$

$\frac{4}{3} \div \frac{5}{6}$

$\frac{3}{4} \div \frac{9}{8}$

$\frac{7}{8} \div \frac{3}{4}$

4. $\frac{3}{4} \div \frac{3}{2}$

$\frac{7}{8} \div \frac{5}{16}$

$\frac{4}{16} \div \frac{5}{16}$

$\frac{9}{16} \div \frac{3}{8}$

5. $\frac{7}{16} \div \frac{5}{12}$

$\frac{7}{12} \div \frac{3}{4}$

$\frac{5}{8} \div \frac{5}{12}$

$\frac{3}{10} \div \frac{2}{5}$

6. $\frac{4}{5} \div \frac{3}{10}$

$\frac{7}{10} \div \frac{3}{5}$

$\frac{7}{6} \div \frac{2}{3}$

$\frac{3}{4} \div \frac{15}{16}$

7. $\frac{5}{16} \div \frac{5}{8}$

$\frac{9}{10} \div \frac{6}{5}$

$\frac{15}{4} \div \frac{25}{16}$

$\frac{20}{3} \div \frac{5}{6}$

8. $\frac{7}{20} \div \frac{3}{10}$

$\frac{5}{4} \div \frac{7}{12}$

$\frac{30}{20} \div \frac{9}{10}$

$\frac{7}{10} \div \frac{2}{15}$

9. $1\frac{1}{2} \div \frac{1}{2}$

$2\frac{1}{2} \div \frac{1}{2}$

$1\frac{2}{3} \div \frac{1}{3}$

$3\frac{1}{3} \div \frac{1}{3}$

SUGGESTION. $1\frac{1}{2} \div \frac{1}{2} = \frac{3}{2} \div \frac{1}{2}$.

10. $2\frac{1}{4} \div \frac{1}{4}$

$3\frac{2}{3} \div \frac{2}{3}$

$6\frac{2}{3} \div \frac{2}{3}$

$2\frac{1}{2} \div \frac{1}{4}$

11. $7\frac{1}{2} \div \frac{1}{2}$

$6\frac{1}{2} \div \frac{3}{4}$

$12\frac{1}{2} \div \frac{1}{2}$

$8\frac{1}{3} \div \frac{2}{3}$

12. $10\frac{2}{5} \div \frac{2}{5}$

$12\frac{1}{2} \div \frac{3}{4}$

$16\frac{2}{3} \div \frac{2}{3}$

$18\frac{3}{4} \div \frac{3}{4}$

13. $2\frac{1}{2} \div 7\frac{1}{2}$

$12\frac{1}{2} \div 2\frac{1}{2}$

$6\frac{2}{3} \div 1\frac{2}{3}$

$6\frac{1}{4} \div 12\frac{1}{2}$

SUGGESTION. $2\frac{1}{2} \div 7\frac{1}{2} = \frac{5}{2} \div \frac{15}{2}$.

14. $7\frac{1}{2} \div 2\frac{1}{2}$

$2\frac{1}{2} \div 12\frac{1}{2}$

$1\frac{1}{3} \div 6\frac{2}{3}$

$6\frac{1}{4} \div 3\frac{1}{8}$

15. $10\frac{2}{3} \div 5\frac{1}{3}$

$12\frac{1}{2} \div 6\frac{1}{4}$

$6\frac{1}{4} \div 18\frac{3}{4}$

$8\frac{1}{3} \div 16\frac{2}{3}$

16. $16\frac{2}{3} \div 8\frac{1}{3}$

$18\frac{3}{4} \div 6\frac{1}{4}$

$14\frac{2}{7} \div 28\frac{4}{7}$

$42\frac{6}{7} \div 14\frac{2}{7}$

17. $12\frac{1}{2} \div 18\frac{3}{4}$

$37\frac{1}{2} \div 2\frac{1}{2}$

$37\frac{1}{2} \div 7\frac{1}{2}$

$18\frac{3}{4} \div 12\frac{1}{2}$

18. $12\frac{1}{2} \div 37\frac{1}{2}$

$2\frac{1}{2} \div 37\frac{1}{2}$

$62\frac{1}{2} \div 12\frac{1}{2}$

$87\frac{1}{2} \div 62\frac{1}{2}$

19. $37\frac{1}{2} \div 12\frac{1}{2}$

$62\frac{1}{2} \div 37\frac{1}{2}$

$12\frac{1}{2} \div 62\frac{1}{2}$

$62\frac{1}{2} \div 87\frac{1}{2}$

20. $16\frac{2}{3} \div 33\frac{1}{3}$

$66\frac{2}{3} \div 33\frac{1}{3}$

$16\frac{2}{3} \div 66\frac{2}{3}$

$33\frac{1}{3} \div 66\frac{2}{3}$

PROBLEMS

1. Mr. Means has $\frac{5}{8}$ of an acre of land which some boys wish to use for home gardens. He decided to divide it into gardens each containing $\frac{1}{16}$ of an acre. How many gardens of this size will it make?
2. How many hair ribbons each containing $1\frac{1}{2}$ yd. can be cut from a piece of ribbon $4\frac{1}{2}$ yd. long?
3. If a United States flag is 5 ft. wide, how wide is each stripe?
4. If $\frac{5}{4}$ cu. ft. is equal to one bushel, how many bushels will a box of 30 cu. ft. hold?
5. Some boxes of berries contain only $\frac{1}{2}$ as much as others. How many of the smaller must be taken to make 1 of the larger? 2 of the larger? if some are only $\frac{1}{4}$ as large as others?
6. If the distance around John's hoop is $6\frac{2}{3}$ ft., how many times will it turn in rolling 100 ft.?
7. One barrel (a measure) equals $31\frac{1}{2}$ gal. and one hogshead (a measure) equals 63 gal. How many barrels are there in a hogshead?
8. How many rods are there in 121 yd.? (1 rd. = $5\frac{1}{2}$ yd.)
9. Mrs. Andrews paid 75¢ for $2\frac{1}{2}$ lb. of ham. How much was that per pound?
10. How many strips of carpet each $\frac{3}{4}$ yd. wide are needed to cover a floor 6 yd. wide?
11. Samuel picked strawberries for 2 hr., picking 1 box each $\frac{1}{4}$ hr. How many boxes did he pick?
12. The product of two fractions is $\frac{7}{12}$; one of them is $\frac{1}{2}$. What is the other?
13. Gladys paid 24¢ for $\frac{3}{4}$ yd. of ribbon. What was the price per yard?
14. If the yield of wheat from $\frac{3}{4}$ of an acre was 18 bu., what was the yield per acre?

COMPARISON

Each number in the first line is how many times the number under it in the second line?

6	2	80	9	12	12	12	8	10	10
2	1	4	3	6	2	3	2	2	5

Each number in the second line is what part of the number over it in the first line?

Supply the missing fractions as is done in the first three, expressing all fractions in lowest terms:

1. $3 = \frac{1}{2}$ of 6	$4 = \frac{2}{3}$ of 6	$12 = \frac{3}{2}$ of 8	$4 = \text{—}$ of 8
2. $5 = \text{—}$ of 10	$2 = \text{—}$ of 6	$2 = \text{—}$ of 10	$1 = \text{—}$ of 3
3. $2 = \text{—}$ of 3	$1 = \text{—}$ of 4	$2 = \text{—}$ of 4	$3 = \text{—}$ of 4
4. $1 = \text{—}$ of 6	$2 = \text{—}$ of 12	$3 = \text{—}$ of 15	$4 = \text{—}$ of 10
5. $5 = \text{—}$ of 6	$1 = \text{—}$ of 5	$3 = \text{—}$ of 5	$1 = \text{—}$ of 8
6. $2 = \text{—}$ of 8	$3 = \text{—}$ of 8	$4 = \text{—}$ of 16	$5 = \text{—}$ of 8
7. $6 = \text{—}$ of 8	$7 = \text{—}$ of 8	$1 = \text{—}$ of 12	$2 = \text{—}$ of 14
8. $3 = \text{—}$ of 12	$4 = \text{—}$ of 12	$5 = \text{—}$ of 12	$6 = \text{—}$ of 12
9. $7 = \text{—}$ of 12	$8 = \text{—}$ of 12	$9 = \text{—}$ of 12	$10 = \text{—}$ of 12

Supply the missing number as is done in the first two:

10. $2 = \frac{1}{2}$ of 4	$6 = \frac{2}{3}$ of 9	$3 = \frac{1}{2}$ of —	$5 = \frac{1}{2}$ of —
11. $2 = \frac{1}{3}$ of —	$3 = \frac{1}{3}$ of —	$4 = \frac{1}{4}$ of —	$8 = \frac{1}{2}$ of —
12. $4 = \frac{2}{3}$ of —	$9 = \frac{3}{4}$ of —	$8 = \frac{2}{3}$ of —	$10 = \frac{2}{5}$ of —
13. $6 = \frac{3}{5}$ of —	$10 = \frac{2}{3}$ of —	$12 = \frac{2}{3}$ of —	$12 = \frac{3}{4}$ of —
14. $9 = \frac{3}{5}$ of —	$16 = \frac{2}{3}$ of —	$12 = \frac{4}{5}$ of —	$16 = \frac{4}{5}$ of —

PROBLEMS IN COMPARISON

1. Draw a line 1 foot long and divide it into inches; then tell what part of a foot there is in:

6 in. 4 in. 2 in. 3 in. 8 in.

2. What part of a dozen is 1? 2? 3? 4? 6? 8? 9?
3. If oranges are 40¢ a dozen, what is the cost of 6? of 8? If bananas are 60¢ a dozen, what is the cost of 8? of 10?
4. Two neighbors, Mr. Ray and Mr. Holmes, bought a barrel of apples for \$6. Mr. Ray paid \$2 and Mr. Holmes \$4. What part of the barrel should Mr. Ray have? What part should Mr. Holmes have?
5. Martha and Amanda bought some Christmas balls of the same kind for 75¢. Martha paid 25¢ and Amanda 50¢. What part of the balls should Martha have? What part should Amanda have?
6. If there were a dozen balls (see example 5), how many of them should Martha have? How many should Amanda have?
7. James and William were paid 75¢ for mowing a lawn. James worked 1 hour and William worked 2 hours. How much should each have of the 75¢?

ACCURACY AND SPEED TESTS

Try to get the results in each test of this exercise in 2 minutes or less. All fractions in the results must be in lowest terms.

ADDITION

Test 1

$$\begin{array}{r} \frac{1}{3} \\ \frac{1}{3} \\ \hline \end{array} \quad \begin{array}{r} \frac{5}{8} \\ \frac{1}{8} \\ \hline \end{array} \quad \begin{array}{r} \frac{9}{16} \\ \frac{5}{16} \\ \hline \end{array} \quad \begin{array}{r} \frac{1}{9} \\ \frac{5}{9} \\ \hline \end{array}$$

Test 2

$$\begin{array}{r} \frac{1}{6} \\ \frac{1}{3} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{10} \\ \frac{1}{5} \\ \hline \end{array} \quad \begin{array}{r} \frac{1}{12} \\ \frac{2}{3} \\ \hline \end{array}$$

Test 3

$$\begin{array}{r} \frac{1}{2} \\ \frac{5}{8} \\ \hline \end{array} \quad \begin{array}{r} \frac{11}{12} \\ \frac{3}{4} \\ \hline \end{array} \quad \begin{array}{r} \frac{2}{3} \\ \frac{11}{15} \\ \hline \end{array} \quad \begin{array}{r} \frac{7}{10} \\ \frac{4}{5} \\ \hline \end{array}$$

Test 4

$$\begin{array}{r} \frac{1}{3} \\ \frac{3}{4} \\ \hline \end{array} \quad \begin{array}{r} \frac{8}{9} \\ \frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} \frac{2}{3} \\ \frac{2}{5} \\ \hline \end{array}$$

Test 5

$$\begin{array}{r} \frac{1}{4} \\ \frac{1}{8} \\ \hline \end{array} \quad \begin{array}{r} \frac{2}{9} \\ \frac{5}{12} \\ \hline \end{array} \quad \begin{array}{r} \frac{1}{6} \\ \frac{1}{9} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{4} \\ \frac{1}{10} \\ \hline \end{array}$$

Test 6

$$\begin{array}{r} 2\frac{1}{2} \\ 1\frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} 3\frac{3}{4} \\ 1\frac{1}{4} \\ \hline \end{array} \quad \begin{array}{r} 3\frac{1}{4} \\ 2\frac{1}{2} \\ \hline \end{array}$$

SUBTRACTION

Test 1

$$\begin{array}{r} \frac{4}{5} \\ \frac{2}{5} \\ \hline \end{array} \quad \begin{array}{r} \frac{7}{8} \\ \frac{3}{8} \\ \hline \end{array} \quad \begin{array}{r} \frac{11}{12} \\ \frac{1}{3} \\ \hline \end{array} \quad \begin{array}{r} \frac{11}{12} \\ \frac{1}{4} \\ \hline \end{array}$$

Test 2

$$\begin{array}{r} \frac{1}{2} \\ \frac{2}{5} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{5} \\ \frac{1}{2} \\ \hline \end{array} \quad \begin{array}{r} \frac{3}{4} \\ \frac{1}{6} \\ \hline \end{array} \quad \begin{array}{r} \frac{5}{6} \\ \frac{5}{8} \\ \hline \end{array}$$

Test 3

$$\begin{array}{r} 2\frac{1}{2} \\ 5 \\ \hline \end{array} \quad \begin{array}{r} 4\frac{5}{12} \\ 2 \\ \hline \end{array} \quad \begin{array}{r} 4\frac{5}{8} \\ \frac{1}{8} \\ \hline \end{array} \quad \begin{array}{r} 4\frac{3}{4} \\ \frac{1}{2} \\ \hline \end{array}$$

Test 4

$$\begin{array}{r} 2\frac{3}{4} \\ 1\frac{1}{4} \\ \hline \end{array} \quad \begin{array}{r} 3\frac{7}{12} \\ 1\frac{5}{12} \\ \hline \end{array} \quad \begin{array}{r} 4\frac{7}{12} \\ 1\frac{1}{4} \\ \hline \end{array} \quad \begin{array}{r} 3\frac{9}{16} \\ 1\frac{3}{8} \\ \hline \end{array}$$

Test 5

$$\begin{array}{r} 4 \\ 2\frac{3}{8} \\ \hline \end{array} \quad \begin{array}{r} 5 \\ 3\frac{2}{5} \\ \hline \end{array} \quad \begin{array}{r} 6 \\ 3\frac{7}{12} \\ \hline \end{array} \quad \begin{array}{r} 8 \\ 2\frac{5}{16} \\ \hline \end{array}$$

Test 6

$$\begin{array}{r} 4\frac{1}{8} \\ 1\frac{7}{8} \\ \hline \end{array} \quad \begin{array}{r} 4\frac{5}{12} \\ 3\frac{7}{12} \\ \hline \end{array} \quad \begin{array}{r} 3\frac{1}{2} \\ 1\frac{1}{4} \\ \hline \end{array} \quad \begin{array}{r} 4\frac{1}{5} \\ 2\frac{7}{10} \\ \hline \end{array}$$

ACCURACY AND SPEED TESTS

Try to get the result in each test in this exercise in 2 minutes or less. Remember to reduce all improper fractions in the results to whole or mixed numbers and all fractions to lowest terms.

MULTIPLICATION

<i>Test 1.</i>	$2 \times \frac{1}{7}$	$2 \times \frac{5}{8}$	$12 \times \frac{5}{8}$	$9 \times \frac{5}{8}$
<i>Test 2.</i>	$2 \times 3\frac{1}{2}$	$2 \times 3\frac{1}{4}$	$3 \times 2\frac{2}{3}$	$3 \times 2\frac{5}{6}$
<i>Test 3.</i>	$\frac{1}{8} \times 5$	$\frac{1}{12} \times 6$	$\frac{5}{9} \times 9$	$\frac{5}{9} \times 6$
<i>Test 4.</i>	$2\frac{1}{2} \times 4$	$2\frac{3}{4} \times 8$	$2\frac{2}{5} \times 5$	$2\frac{3}{4} \times 6$
<i>Test 5.</i>	$\frac{1}{2} \times \frac{3}{8}$	$\frac{8}{15} \times \frac{3}{4}$	$8\frac{1}{2} \times \frac{1}{2}$	$\frac{2}{3} \times 4\frac{1}{2}$
<i>Test 6.</i>	$2\frac{1}{2} \times 3\frac{1}{3}$	$1\frac{2}{3} \times 4\frac{1}{5}$	$2\frac{1}{5} \times 7\frac{1}{2}$	$6\frac{2}{3} \times 3\frac{3}{4}$

DIVISION

<i>Test 1.</i>	$2 \div 3$	$3 \div 2$	$5 \div 2$	$2 \div 5$
<i>Test 2.</i>	$\frac{3}{8} \div 3$	$\frac{9}{10} \div 3$	$\frac{1}{4} \div 4$	$\frac{3}{8} \div 2$
<i>Test 3.</i>	$2 \div \frac{1}{4}$	$4 \div \frac{1}{3}$	$6 \div \frac{2}{3}$	$5 \div \frac{2}{3}$
<i>Test 4.</i>	$6\frac{2}{3} \div 2$	$9\frac{3}{5} \div 3$	$4\frac{1}{4} \div 2$	$5\frac{3}{5} \div 2$
<i>Test 5.</i>	$\frac{2}{5} \div \frac{3}{4}$	$\frac{3}{5} \div \frac{5}{4}$	$\frac{9}{10} \div \frac{3}{5}$	$\frac{9}{16} \div \frac{3}{8}$
<i>Test 6.</i>	$4\frac{1}{2} \div \frac{3}{8}$	$5 \div 2\frac{1}{2}$	$10 \div 3\frac{1}{3}$	$1\frac{1}{2} \div 2\frac{1}{4}$

REVIEW

1. Name four integers; name five mixed numbers.
2. Name four proper fractions; four improper fractions.
3. In the fraction $\frac{3}{4}$ name the numerator; the denominator; the terms.
4. How can you tell whether a fraction is a proper fraction or an improper fraction? Give examples.
5. If you multiply both terms of a fraction, as $\frac{3}{4}$, by 2, what is the resulting fraction? Has it the same value as $\frac{3}{4}$? Draw on the blackboard a line 1 foot long and show by it that your answer is correct.
6. If you divide both terms of $\frac{6}{8}$ by 2, what is the resulting fraction? Has it the same value as $\frac{6}{8}$?
7. Name four fractions in lowest terms; four not in lowest terms.
8. How can you tell when a fraction is in lowest terms? Illustrate.
9. If a fraction is not in lowest terms, how do you reduce it to lowest terms? Illustrate.
10. How do you add two fractions which have a common denominator, as $\frac{3}{8}$ and $\frac{1}{8}$? How do you subtract them?
11. How do you add two fractions which do not have a common denominator, as $\frac{3}{4}$ and $\frac{2}{3}$? How do you subtract them?
12. Would you find the answer to $2 \times \frac{3}{8}$ in the same way that you would find the answer to $2 \times \frac{2}{5}$? What is the answer in each case?
13. Would you find the answer to $\frac{4}{5} \div 2$ in the same way that you would find the answer to $\frac{3}{4} \div 2$? What is the answer in each case?

REVIEW

1. Anita's mother bought her 3 hair ribbons, each containing $1\frac{1}{4}$ yd. How many yards did the 3 ribbons contain?
2. Dora's mother used 4 lb. of sugar in canning peaches, $\frac{1}{4}$ lb. to each quart can. How many quart cans did she put up?
3. How much bread will a family waste in a year (52 weeks) by wasting $1\frac{1}{2}$ slices weekly, counting 12 slices to a 10¢ loaf?

Copy, supplying the missing numbers :

4. $\frac{1}{8}$ of 100 = $\frac{5}{8}$ of 100 = $\frac{2}{3}$ of 100 = $\frac{1}{7}$ of 100 =
5. $\frac{2}{8}$ or $\frac{1}{4}$ of 100 = $\frac{6}{8}$ or $\frac{3}{4}$ of 100 = $\frac{1}{6}$ of 100 = $\frac{1}{9}$ of 100 =
6. $\frac{3}{8}$ of 100 = $\frac{7}{8}$ of 100 = $\frac{5}{6}$ of 100 = $\frac{1}{12}$ of 100 =
7. $\frac{4}{8}$ or $\frac{1}{2}$ of 100 = $\frac{1}{3}$ of 100 = $\frac{5}{12}$ of 100 = $\frac{7}{12}$ of 100 =
8. At a banquet $\frac{1}{4}$ lb. of butter was served to 6 persons, to each the same amount. What part of a pound was served to each? Was this a liberal helping? With butter at 72¢ a pound what did the butter for each person cost?

Copy, supplying the missing numbers as in the first :

9. $\frac{1}{2}$ of \$1.00 = 50¢ $\frac{1}{5}$ of \$1.00 = $\frac{3}{8}$ of \$1.00 =
10. $\frac{1}{3}$ of \$1.00 = $\frac{1}{6}$ of \$1.00 = $\frac{5}{8}$ of \$1.00 =
11. $\frac{1}{4}$ of \$1.00 = $\frac{1}{8}$ of \$1.00 = $\frac{7}{8}$ of \$1.00 =
12. In buying lump sugar you can get large lumps weighing about $\frac{2}{5}$ oz. each. How many of these lumps are there in a pound (16 oz.)?
13. Lump sugar can be bought in lumps weighing $\frac{1}{5}$ oz. each. How many of these lumps make a pound?

REVIEW

1. If each member of a family of 5 uses $\frac{1}{8}$ lb. of butter daily, what is the cost of the butter they use in a week at 56¢ a pound?

2. Clara was drinking $\frac{1}{2}$ qt. of milk each day, but she increased her use of this food by $\frac{1}{4}$ qt. a day. How much was she then using and what was its cost at 16¢ a quart?
3. At \$1.00 a yard, what is the exact cost of $\frac{1}{8}$ yd. of ribbon? How much would you actually pay the clerk?
4. John has a half dollar and Sarah has a piece of money worth half as much as John's piece. What part of a dollar is Sarah's worth?
5. Philip gets a 50-pound piece of ice at a plant for 15¢, but before he reaches home with it, $\frac{1}{10}$ of it has melted away. What does the piece weigh when Philip has reached home, and what is the money loss?
6. William's father owns a lot containing $\frac{3}{4}$ of an acre. He gave 6 boys the use of it for a garden. What part of an acre does each boy's garden contain if they share the lot equally?
7. In Mrs. Boyd's home $\frac{1}{4}$ lb. of tea is used in making tea for 8 meals. What part of a pound is used for each meal?
8. What is the cost of $2\frac{1}{2}$ tons of coal at \$16.00 a ton?
9. If a family wastes $\frac{1}{4}$ lb. of butter a week, what is the money loss in 52 weeks with butter 48¢ a pound?
10. If your recipe calls for 2 lb. of flour and you know that 1 cup of flour is $\frac{1}{4}$ lb., how many cups do you need to have 2 lb.?

REVIEW

1. There are 16 tablespoonfuls to a cup. How many tablespoonfuls are there in $\frac{1}{2}$ cup? $\frac{3}{4}$ cup? (A tablespoonful means a *level* tablespoonful.)
2. Two cups of granulated sugar make a pound; 1 cup is what part of a pound? What does a cup of granulated sugar cost when a pound costs 10¢?

3. Mrs. White bought 2 lb. of cheese at 42¢ a pound. Because she did not keep it in a proper way, $\frac{1}{4}$ of it was lost by molding. What was the money loss?

4. Mrs. Miller raised 120 early tomatoes worth 5¢ each; she let $\frac{1}{5}$ of them rot on the vines. What was the money loss?

5. Anna made fudge in a pan which weighed $\frac{1}{2}$ lb. The pan and the fudge weighed $1\frac{3}{4}$ lb. What was the weight of the fudge?

6. To make the quantity of fudge called for in example 5, Anna used this

RECIPE FOR FUDGE

1 cup milk
1 lb. sugar

$1\frac{1}{2}$ oz. cocoa
 $\frac{1}{2}$ oz. butter

How much of each ingredient given in the recipe is required to make half the quantity that Anna made? How much is half the quantity which she made? To make twice the quantity which she made? How much is twice the quantity which she made?

7. State how you divide by a fraction and illustrate by finding the answer to:

$$3 \div \frac{3}{4}$$

$$4 \div \frac{3}{4}$$

$$\frac{2}{3} \div \frac{3}{4}$$

$$2\frac{1}{2} \div \frac{1}{10}$$

REVIEW

1. One cup of sugar is $\frac{1}{2}$ lb. How many cups of sugar do you need to have $2\frac{1}{2}$ lb.?

2. Beef loses about $\frac{1}{5}$ of its weight in roasting. A piece of raw beef weighing $2\frac{1}{2}$ lb. should weigh how much when roasted? How many persons should it serve, allowing each person $\frac{1}{3}$ lb. of roast beef?

3. What is the cost of one article if you buy:

6 for 1¢?

8 for 1¢?

10 for 1¢?

12 for 1¢?

5 for 3¢?

6 for 10¢?

3 for 5¢?

5 for 2¢?

10 for 3¢?

2 for 25¢?

8 for 25¢?

2 for 75¢?

4. What is the exact cost of 1 apple when 3 apples are bought for 25¢?

5. A soldier's ration of sugar is $3\frac{1}{5}$ oz. a day. How many days will a pound of sugar supply a soldier?

6. A quart of milk weighs $2\frac{1}{2}$ lb. What does a gallon of milk weigh?

7. There are 32 tablespoonfuls in a pint. What is the cost of a tablespoonful of cream at 30¢ a pint?

8. What is the answer to $\frac{2}{3} \times \frac{4}{5}$? Can you cancel in this example?

9. What is the answer to $\frac{3}{4} \times \frac{4}{5}$? Can you cancel in this example?

10. With a rule draw a line $\frac{3}{4}$ in. and divide it into 2 equal parts. How long is each part?

11. Isabel used 6 balls of worsted yarn, each ball weighing $1\frac{1}{2}$ oz. in making herself a sweater. What was the weight of the sweater and what did it cost, the price of the yarn being 70¢ a ball?

12. What is the cost of 1 shredded wheat biscuit if a package of one dozen costs 15¢?

13. What was the cost of 1 egg when eggs were 84¢ a dozen of 2 eggs? of 3 eggs?

14. Herman and Walter received 50¢ for picking 10 boxes of strawberries. Herman picked 6 boxes and Walter 4 boxes. What part of the 10 boxes did Herman pick? What part did Walter pick? How much did Herman receive? How much did Walter receive?

15. How many boxes each holding $\frac{1}{2}$ lb. of candy can be filled from a box containing 25 lb. of candy? How many pounds of candy will 25 of the smaller boxes hold?

16. What should Clarence be paid for working from 9.15 A.M. until 10.00 A.M. at 40¢ an hour?

CHAPTER III

DECIMALS

Tenths, Hundredths, and Thousandths. If anything, as the square (Figure 1), is divided into ten equal parts, what is each part called?

If anything, as the square (Figure 2), is divided into one hundred equal parts, can you tell what each of these parts is called?

If each of the small squares in Figure 2 is divided into ten equal parts, the whole square is divided into one thousand equal parts, and each part is called *one thousandth*.

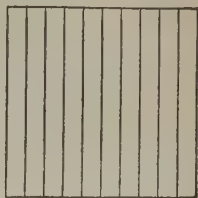


FIGURE 1

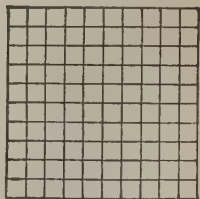


FIGURE 2

Decimals. Tenths, hundredths, and thousandths are much used not only in school work but also in the everyday problems that are met with outside of school. They are written and used not only in the form in which halves, thirds or eighths are, that is, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, but also in the form in which whole numbers are written and used.

Thus: one tenth = .1
 one hundredth = .01
 one thousandth = .001

In this form they are usually called *decimals*.

Tenths. Compare these two ways of writing tenths:

Fractional Form: $\frac{1}{10}$ $\frac{2}{10}$ $\frac{3}{10}$ $\frac{5}{10}$ $\frac{7}{10}$ $\frac{9}{10}$

Decimal Form: .1 .2 .3 .5 .7 .9

NOTE. Instead of .1 we may write 0.1; also, 0.2 instead of .2, and so on.

Common Fractions. Fractions that have their denominators expressed, as $\frac{1}{2}$, $\frac{3}{4}$, $\frac{1}{10}$, are called *common fractions*.

READING AND WRITING TENTHS

1. Read these decimals:

.5 .4 .6 .7 .1 .3 .2 .9

2. Read 2.5. Thus, *two and five tenths*.

3. Read 2.0. Thus, *two*.

4. Read these records of the greatest depth of snow in New York in February for five years in succession: 12.0 in.; 3.4 in.; 5.3 in.; 3.6 in.; 4.4 in.

5. Read these numbers which Samuel found in a magazine then write them from dictation:

.8 4.6 3.2 .3 5.9 .6 .2 5
.4 9.4 .7 3.8 1.4 .5 4.4 7

6. Write as decimals:

$\frac{4}{10}$ $\frac{6}{10}$ $\frac{8}{10}$ $\frac{9}{10}$ $\frac{7}{10}$ 2 tenths 6 tenths 9 tenths

7. Write the 9 numbers in example 1 in a column as your teacher dictates them, keeping the decimal points in a column.

8. Write the 5 numbers in example 4 in a column as your teacher dictates them, keeping the decimal points in a column.

9. Write the 16 numbers in example 5 in a column as your teacher dictates them, keeping the decimal points in a column.

10. Write each of the numbers in example 5 in fractional form or as a mixed number, and reduce all fractions to lowest terms.

Hundredths. Compare these two ways of writing hundredths :

Fractional Form : $\frac{1}{100}$ $\frac{2}{100}$ $\frac{5}{100}$ $\frac{10}{100}$ $\frac{25}{100}$ $\frac{75}{100}$

Decimal Form : .01 .02 .05 .10 .25 .75

READING AND WRITING HUNDREDTHS

1. Read these decimals :

6	.08	.15	.36	.45	.82	.90	.95
7	.18	.24	.92	.73	.62	.37	.84

2. Read 1.75. Thus, *one and seventy-five hundredths*.

3. Read these numbers :

5	1.15	2.25	3.06	8.32	9.56	9.75
8	9.25	3.12	9.95	8.48	7.64	8.88

4. Write as decimals; also write the first 8, using words in place of the denominators :

6	$\frac{9}{100}$	$\frac{32}{100}$	$\frac{85}{100}$	$\frac{72}{100}$	$\frac{99}{100}$	$\frac{22}{100}$	$\frac{48}{100}$
	hundredths	22 hundredths	78 hundredths	93 hundredths			

5. Write the 16 numbers in example 1 in a column as your teacher dictates them, keeping the decimal points in a column.

6. Write the 14 numbers in example 3 in a column as your teacher dictates them, keeping the decimal points in a column.

Thousandths. Compare these two ways of writing thousandths :

Fractional Form : $\frac{1}{1000}$ $\frac{5}{1000}$ $\frac{25}{1000}$ $\frac{150}{1000}$ $\frac{725}{1000}$ $\frac{892}{1000}$

Decimal Form : .001 .005 .025 .150 .725 .892

READING AND WRITING THOUSANDTHS

1. Read these decimals :

4	.075	.125	.375	.625	.875	.800
7	.065	.248	.426	.581	.309	.907

2. Read 2.386. Thus, *two and three hundred eighty-six thousandths*.

3. Read these numbers; then write them from dictation:

2.758	4.385	2.106	5.025	7.085	9.8
3.125	4.625	8.048	7.052	8.225	9.7

4. Write as decimals; then write the first 6 again, expressing the denominators in words:

$\frac{4}{1000}$	$\frac{9}{1000}$	$\frac{45}{1000}$	$\frac{95}{1000}$	$\frac{275}{1000}$	$\frac{4}{1000}$
8 thousandths	35 thousandths	475 thousandths	850 thousandths		

5. Write 6 of the 14 decimals in example 1 in a column as your teacher dictates them, keeping the decimal points in a column.

6. Write the 12 numbers in example 3 in a column as your teacher dictates them, keeping the decimal points in a column.

Place Value in Decimals. In whole numbers we speak of *units' place*, *tens' place*, *hundreds' place*, *thousands' place*, and so on. In the decimal .576, we say that the figure 5 is in *tenths' place*, the figure 7 in *hundredths' place*, and the figure 6 in *thousandths' place*. The figure written in the first place to the right of the decimal point represents *tenths*; in the second place, *hundredths*; in the third, *thousandths*.

PLACE VALUE IN DECIMALS

1. In .675 what does 6 represent? 7? 5?

2. Read these lengths and tell how many feet the 3 represents in each:

36.7 ft. 63.4 ft. 8.3 ft. 7.03 ft. 9.003 ft.

3. In 87.56 what does 8 represent? 7? 5? 6?

4. In \$29.56 what does 2 represent? 9? 5? 6?

Write the number made up of:

5. 2 tenths and 5 hundredths; 7 tenths and 5 hundredths.

6. 2 hundredths and 5 thousandths. (Think what to write in hundredths' place.)

7. 2 tenths and 5 thousandths. (Think what to write in hundredths' place.)

8. 5 hundredths and 8 thousandths; 2 tenths and 8 thousandths.

9. 2 units and 5 tenths; 2 units and 5 hundredths.

10. 7 hundreds, 2 tens, 4 units, and 6 tenths.

Changing the Form of a Decimal without Changing Its Value.

We have already learned that:

$$\frac{6}{10} = \frac{60}{100} = \frac{600}{1000} \quad (\text{Why?})$$

Another way of stating this is:

$$.6 = .60 = .600$$

1. Annexing ciphers to a decimal does not change its value.
2. Removing ciphers from the right of a decimal does not change its value.

REDUCING DECIMALS

1. Reduce .5 to hundredths. Thus, .5 = .50.

2. Reduce .300 to tenths. Thus, .300 = .3.

3. Reduce to tenths:

.40	.50	.80	.90	.200	.300	.900
-----	-----	-----	-----	------	------	------

4. Reduce to hundredths:

.7	.9	.5	.700	.860	.420	.370
----	----	----	------	------	------	------

5. Reduce to thousandths:

.2	.75	.58	.9	.85	.6	.97
----	-----	-----	----	-----	----	-----

6. Reduce .25 to a common fraction in lowest terms.

Thus, $.25 = \frac{25}{100} = \frac{1}{4}$.

7. Reduce to common fractions or mixed numbers :

.6	.75	7.6	.25	.50	7.5	8.75	3.2
.04	.30	8.15	.35	.20	6.2	5.50	1.3

A common fraction that can easily be reduced to tenths, hundredths, or thousandths may readily be reduced to a decimal ; thus

$$(1) \frac{2}{5} = \frac{4}{10} = .4$$

$$(2) \frac{3}{4} = \frac{75}{100} = .75$$

$$(3) \frac{1}{8} = \frac{125}{1000} = .125$$

8. Reduce to decimals :

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{3}{5}$	$\frac{4}{5}$	$\frac{1}{20}$	$\frac{1}{25}$	$\frac{1}{50}$
$\frac{3}{20}$	$\frac{4}{25}$	$\frac{3}{50}$	$\frac{9}{25}$	$\frac{7}{50}$	$\frac{3}{8}$	$\frac{5}{8}$

United States Money. The standard unit of value in the United States is the *dollar*.

10 mills (m.)	= 1 cent (ct., ¢, or c)
10 cents	= 1 dime (d.)
10 dimes	= 1 dollar (\$)
10 dollars	= 1 eagle (E.)

UNITED STATES MONEY

1. Repeat the table of United States money.
2. How many dimes make a dollar? How many cents?
3. One dime is what part of a dollar?
4. One cent is what part of a dollar?
5. How many mills make a dollar? 1 mill is what part of \$

A dime equals $\frac{1}{10}$ of a dollar, a cent $\frac{1}{100}$ of a dollar, and a mill $\frac{1}{1000}$ of a dollar. Any sum of money stated as dollars, dimes, cents, and mills may be expressed in dollars, as follows: Place the number of dollars as a whole number, the number of dimes in the tenths' place, the number of cents in the hundredths' place, and the number of mills in the thousandths' place.

For example :

5 dollars 4 dimes 6 cents may be written \$5.46, and read *5 dollars 46 cents*; may also be read *5.46 dollars*.

2 dollars 7 dimes 5 cents 4 mills may be written \$2.754, and read *2 dollars 5 cents 4 mills*; it may also be read *2.754 dollars*.

6. In \$4.875, what does 4 represent? 8? 7? 5?

7. Tell for what part of a dollar each of the figures to the right of the decimal point stands: \$0.75; \$0.628.

8. Using the dollar sign write the following in a column, keeping the decimal points in a line: 3 dollars, 2 dimes, and 3 cents; 4 dollars, 1 dime, and 1 cent; 5 dollars, 2 cents, and 5 mills; 7 dollars, 2 dimes, and 3 mills; 7 dimes and 4 mills; 2 dollars, 3 cents, and 4 mills.

9. Using the dollar sign, write these sums of money: 4 dollars, 4 tenths of a dollar, and 5 hundredths of a dollar; 4 tenths of a dollar, 9 hundredths of a dollar, and 4 thousandths of a dollar.

10. Copy this table. Turn to it frequently and review it until you can write from memory any one of these sums of money in three ways:

5¢ = $\frac{1}{20}$ of a dollar = \$.05	40¢ = $\frac{2}{5}$ of a dollar = \$.40
6 $\frac{1}{4}$ ¢ = $\frac{1}{16}$ " " " = .06 $\frac{1}{4}$	50¢ = $\frac{1}{2}$ " " " = .50
8 $\frac{1}{2}$ ¢ = $\frac{1}{12}$ " " " = .08 $\frac{1}{3}$	60¢ = $\frac{3}{5}$ " " " = .60
10¢ = $\frac{1}{10}$ " " " = .10	62 $\frac{1}{2}$ ¢ = $\frac{5}{8}$ " " " = .625
12 $\frac{1}{2}$ ¢ = $\frac{1}{8}$ " " " = .125	66 $\frac{2}{3}$ ¢ = $\frac{2}{3}$ " " " = .66 $\frac{2}{3}$
16 $\frac{2}{3}$ ¢ = $\frac{1}{6}$ " " " = .16 $\frac{2}{3}$	70¢ = $\frac{7}{10}$ " " " = .70
20¢ = $\frac{1}{5}$ " " " = .20	75¢ = $\frac{3}{4}$ " " " = .75
25¢ = $\frac{1}{4}$ " " " = .25	80¢ = $\frac{4}{5}$ " " " = .80
30¢ = $\frac{3}{10}$ " " " = .30	87 $\frac{1}{2}$ ¢ = $\frac{7}{8}$ " " " = .875
33 $\frac{1}{3}$ ¢ = $\frac{1}{3}$ " " " = .33 $\frac{1}{3}$	90¢ = $\frac{9}{10}$ " " " = .90
37 $\frac{1}{2}$ ¢ = $\frac{3}{8}$ " " " = .375	100¢ = $\frac{10}{10}$ " " " = 1.00

ADDITION OF DECIMALS

1. Find the sum of 3.5, 8.25, and .016.

$$\begin{array}{r} 3.5 \\ 8.25 \\ .016 \\ \hline 11.766 \end{array}$$

Write the decimals so that units of the same order stand in the same column, and add as in addition of whole numbers. The decimal point is always placed between units and tenths.

Add; check by adding downwards:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
2.	.05	1.2	3.24	2.07	1.5
	2.14	3.08	2.008	3.7	2.85
	<u>3.18</u>	<u>7.25</u>	<u>1.75</u>	<u>1.075</u>	<u>1.01</u>
3.	3.04	5.09	3.2	1.406	1.00
	.75	.875	4.86	.54	.27
	1.06	.25	1.075	.127	9.5
	<u>.64</u>	<u>1.05</u>	<u>6.04</u>	<u>1.07</u>	<u>2.05</u>

4. .8, .45, and .075. (Remember what is said under example 1.)

5. .09, 2.5, and .87.

6. .075, 2.35, and 1.7.

7. 3.03, 7.755, and .04.

8. 3.25, .325, and 32.5.

9.	10.	11.	12.	13.
\$1.75	\$2.04	\$0.04	\$3.02	\$9.
0.06	5.40	0.26	0.17	1.
<u>2.45</u>	<u>1.06</u>	<u>2.48</u>	<u>3.09</u>	<u>7.</u>
\$	\$	\$	\$	\$
14.	15.	16.	17.	18.
\$4.12	\$3.92	\$9.125	\$7.467	\$7.2
3.064	4.175	3.365	3.213	3.5
<u>4.186</u>	<u>3.485</u>	<u>4.48</u>	<u>4.98</u>	<u>7.9</u>
\$	\$	\$	\$	\$

PROBLEMS

1. James bought a baseball cap for \$1.16 and a baseball belt for \$0.75. How much did he pay for both?
2. When Charles entered high school, the school record for high jump was 5.1 feet; but Charles beat this record by .2 of a foot. What was the school record then?
3. Six girls of the fifth grade had a Saturday afternoon party in the school grounds. Their expenses were: table decoration, \$0.30; sandwiches, \$0.60; ice cream, \$0.72; salted peanuts, \$0.25; fudge, \$0.40. What were the total expenses?
4. Mabel's father was earning \$154.32 a month. What were his monthly earnings after he had two increases, one of \$21.32 per month and another of \$21.86 per month?
5. George's teacher has a tape measure marked off in feet and tenths of feet. George and Frank used it to measure the four sides of their school yard. They found them to be 149.8 ft., 120.2 ft., 149.9 ft., and 121.6 ft. What is the distance around the school yard?
6. George and Frank measured the distance from the center of the walk in front of the school to the center of the walk in front of Frank's home. They found this distance to be 1026.8 ft., which they called the distance from Frank's home to the school. How far must Frank walk in going to and from school? Do you now just how far you must walk in going to and from school?
7. When Dorothy was 11 years old, her height was 53.4 in. and her weight 68.8 lb. During the next year she grew 2.5 in. in height and gained 9.5 lb. in weight. What were her height and weight when she was 12 years old?

SUBTRACTION OF DECIMALS

1. From 9.25 take 7.9.

$$\begin{array}{r} 9.25 \\ 7.9 \\ \hline 1.35 \end{array}$$

2. From 7.8 take 2.125.

$$\begin{array}{r} 7.800 \\ 2.125 \\ \hline 5.675 \end{array}$$

Write the numbers so that units of the same order stand in the same column and subtract as in subtraction of whole numbers. The decimal point is always placed between units and tenths.

Subtract; check by adding the difference to the subtrahend:

$$\begin{array}{r} 3. \\ 7.38 \\ 1.24 \\ \hline \end{array}$$

$$\begin{array}{r} 4. \\ 9.88 \\ 2.7 \\ \hline \end{array}$$

$$\begin{array}{r} 5. \\ 2.40 \\ 1.78 \\ \hline \end{array}$$

$$\begin{array}{r} 6. \\ 9.285 \\ 1.75 \\ \hline \end{array}$$

$$\begin{array}{r} 7. \\ 8.3 \\ 4.1 \\ \hline \end{array}$$

$$\begin{array}{r} 8. \\ 7.1 \\ 2.01 \\ \hline \end{array}$$

$$\begin{array}{r} 9. \\ 6.5 \\ 2.075 \\ \hline \end{array}$$

$$\begin{array}{r} 10. \\ 3.85 \\ 2.005 \\ \hline \end{array}$$

$$\begin{array}{r} 11. \\ 7.35 \\ 1.875 \\ \hline \end{array}$$

$$\begin{array}{r} 12. \\ 4.2 \\ 3.3 \\ \hline \end{array}$$

13. 4.27 from 5.375. (Remember what is said under example 1 and 2.)

14. .07 from 2.7.

15. 3.75 from 11.7.

16. 2.07 from 9.

17. 1.005 from 3.28.

18. .756 from 2.

19. 2.004 from 8

$$\begin{array}{r} 20. \\ \$7.255 \\ 1.40 \\ \hline \$ \end{array}$$

$$\begin{array}{r} 21. \\ \$3.00 \\ 1.755 \\ \hline \$ \end{array}$$

$$\begin{array}{r} 22. \\ \$6.505 \\ 1.255 \\ \hline \$ \end{array}$$

$$\begin{array}{r} 23. \\ \$9.08 \\ 2.105 \\ \hline \$ \end{array}$$

$$\begin{array}{r} 24. \\ \$9. \\ 2. \\ \hline \$ \end{array}$$

$$\begin{array}{r} 25. \\ \$7.98 \\ 2.075 \\ \hline \$ \end{array}$$

$$\begin{array}{r} 26. \\ \$9.87 \\ 2.475 \\ \hline \$ \end{array}$$

$$\begin{array}{r} 27. \\ \$8.00 \\ 4.925 \\ \hline \$ \end{array}$$

$$\begin{array}{r} 28. \\ \$7.262 \\ 2.486 \\ \hline \$ \end{array}$$

$$\begin{array}{r} 29. \\ \$7. \\ 2. \\ \hline \$ \end{array}$$

PROBLEMS

1. Ida's uncle took her home in his automobile. When he left home, Ida noticed that the speedometer read 42.7 mi., and when they reached her home, it read 67.2 mi. How many miles did Ida ride to reach home?

TABLE OF HEIGHTS AND WEIGHTS OF CHILDREN

(Compiled by U. S. Government)

AGE	BOYS		GIRLS	
	Height, Inches	Weight, Pounds	Height, Inches	Weight, Pounds
11 years	53.3	70.2	53.4	68.8
12 years	55.1	76.9	55.9	78.3
13 years	57.2	84.8	58.2	88.7
14 years	59.9	94.9	59.9	98.4
15 years	62.3	107.1	61.1	106.1
16 years	65.0	121.0	61.6	112.0

2. Read this table. Thus, a boy, age 11 years, should be 53.3 inches in height and weigh 70.2 pounds; a girl, age 11 years, and so on.

3. From the age of 11 yr. to the age of 12 yr. a boy should increase how much in height? in weight? Answer the same questions for a girl. (Refer to table.)

4. Find what should be a boy's increase in height and weight between the ages of 12 yr. and 13 yr.; 13 yr. and 14 yr.; 14 yr. and 15 yr.; 15 yr. and 16 yr.

5. What should be a girl's increase in height and weight between the ages of 12 yr. and 13 yr.? 13 yr. and 14 yr.? 14 yr. and 15 yr.? 15 yr. and 16 yr.?

6. How near are your height and weight to these standards?

DISTANCES FROM PENNSYLVANIA RAILROAD STATION, NEW YORK	
.0	New York, N. Y.
10.1	Jersey City, N. J.
58.0	Trenton, N. J.
91.3	Philadelphia, Pa.
195.2	Harrisburg, Pa.
326.2	Altoona, Pa.
439.8	Pittsburgh, Pa.
700.7	Lima, O.
760.1	Ft. Wayne, Ind.
880.8	Gary, Ind.
908.2	Chicago, Ill.

7. Read the distance from New York to Ft. Wayne; from New York to Chicago; from New York to each of the other cities named in the table.

8. What is the distance from Philadelphia to Chicago?

9. What is the distance from Pittsburgh to Chicago?

10. Make ten other questions about the distances between cities named in the table and answer them.

Multiplication Involving Decimals.

1. $3 \times .2 = 3 \times \frac{2}{10} = \frac{6}{10} = .6.$
2. $.3 \times 2 = \frac{3}{10} \times 2 = \frac{6}{10} = .6.$
3. $.4 \times .02 = \frac{4}{10} \times \frac{2}{100} = \frac{8}{1000} = .008.$

In example 1, how many decimal places are there in the multiplicand? In the multiplier? In the product? Answer the same questions for examples 2 and 3. In each example how does the number of decimal places in the product compare with the number of decimal places in the multiplicand and multiplier?

There are as many decimal places in the product of two numbers, one or both of which are decimals, as there are in the multiplicand and multiplier together.

MULTIPLICATION INVOLVING DECIMALS

Multiply ; study how the answers are found in 1, 2, and 3 :

1. 7.5 by 3

7.5
3

22.5
2. .25 by .5

.25
.5

.125
3. .075 by 20

.075
20

1.500

Before finding the products in examples 4-7, tell how many decimal places there will be in each product. Check by multiplying a second time.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
4.	$\begin{array}{r} .25 \\ 5 \\ \hline \end{array}$	$\begin{array}{r} 2.5 \\ .5 \\ \hline \end{array}$	$\begin{array}{r} 75 \\ .4 \\ \hline \end{array}$	$\begin{array}{r} 35 \\ .04 \\ \hline \end{array}$	$\begin{array}{r} .85 \\ .3 \\ \hline \end{array}$
5.	$\begin{array}{r} 7.5 \\ .03 \\ \hline \end{array}$	$\begin{array}{r} 25 \\ .002 \\ \hline \end{array}$	$\begin{array}{r} .48 \\ 80 \\ \hline \end{array}$	$\begin{array}{r} .056 \\ 60 \\ \hline \end{array}$	$\begin{array}{r} .048 \\ 50 \\ \hline \end{array}$
6.	$\begin{array}{r} 1.25 \\ .6 \\ \hline \end{array}$	$\begin{array}{r} .045 \\ 7 \\ \hline \end{array}$	$\begin{array}{r} 87.6 \\ .08 \\ \hline \end{array}$	$\begin{array}{r} .48 \\ .9 \\ \hline \end{array}$	$\begin{array}{r} 7.8 \\ 70 \\ \hline \end{array}$
7.	$\begin{array}{r} 6.84 \\ .7 \\ \hline \end{array}$	$\begin{array}{r} .482 \\ 9 \\ \hline \end{array}$	$\begin{array}{r} 76.8 \\ .08 \\ \hline \end{array}$	$\begin{array}{r} 9.32 \\ .6 \\ \hline \end{array}$	$\begin{array}{r} .648 \\ 40 \\ \hline \end{array}$
8.	$\begin{array}{r} \$2.75 \\ 4 \\ \hline \$ \end{array}$	$\begin{array}{r} \$0.375 \\ 6 \\ \hline \$ \end{array}$	$\begin{array}{r} \$3.125 \\ 8 \\ \hline \$ \end{array}$	$\begin{array}{r} \$0.875 \\ 6 \\ \hline \$ \end{array}$	$\begin{array}{r} \$3.625 \\ 8 \\ \hline \$ \end{array}$

Multiplying Decimals by 10, 100, and 1000.

$$1. \quad 10 \times .006 = 10 \times \frac{6}{1000} = \frac{6}{100} = .06.$$

$$2. \quad 100 \times .006 = 100 \times \frac{6}{1000} = \frac{6}{10} = .6.$$

$$3. \quad 1000 \times .006 = 1000 \times \frac{6}{1000} = 6.$$

In 1, 2, and 3 observe the position of the decimal point in the multiplicand and in the product.

Moving the decimal point one place to the right multiplies the number by 10, moving it two places to the right multiplies by 100, moving it three places to the right multiplies by 1000.

MULTIPLYING BY 10, 100, AND 1000

Read; state the products; check examples 1 and 2 by multiplying the integers by the decimals:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1.	$10 \times .3$	$10 \times .9$	$10 \times .5$	$10 \times .1$
2.	$10 \times .04$	$10 \times .005$	$10 \times .07$	$10 \times .00$
3.	10×1.25	$10 \times .125$	10×12.5	$10 \times .37$
4.	$100 \times .06$	100×1.25	$100 \times .125$	100×6.2
5.	$100 \times .005$	$100 \times .075$	$100 \times .045$	$100 \times .45$
6.	$1000 \times .002$	$1000 \times .375$	$1000 \times .75$	1000×2.7

7. What is the railroad fare for 10 mi. at \$0.036 a mile? for 100 mi.? for 1000 mi.?

Find the cost of:

8. 10 fruit trees at \$0.75 each; at \$1.25 each.
9. 10 yd. of lawn at \$0.35 a yard; at \$0.50 a yard.
10. 100 lb. of old newspapers at \$0.01 a pound; at \$0.012 pound; at \$0.015 a pound.

PROBLEMS

1. What was Mrs. Prudden's ice bill for a year if she bought 120 twenty-five-pound pieces at \$0.18 a piece?
2. What is saved by buying a dozen packages of shredded wheat biscuit at \$1.75 rather than buying a single package at time at \$0.15 a package?
3. Mr. Speer uses 10 tons of coal per year. One year he paid \$12.55 a ton; the next year he paid \$15.80 a ton. How much more did his coal cost him the second year than the first?
4. What was the outlay for canned vegetables for a family of five for one year if they used 13 cans of corn at \$0.16 a can, 13 cans of peas at \$0.15 a can, and 52 cans of tomatoes at \$0.15 a can?

5. Mr. Jones used during one winter to heat his two-story house six rooms, 2.5 tons of pea coal at \$13.50 a ton and 2.5 tons of stove coal at \$16.50 a ton. What was his coal bill for the winter?
6. A long-distance telephone message from Gertrude's home in Chicago cost \$0.75 for the first three minutes and \$0.25 for each additional minute. How much must Gertrude pay if the call was five minutes?
7. A long-distance telephone message from John's home to Milwaukee cost \$0.35 for the first three minutes and \$0.10 for each additional minute. How much must he pay to talk to Milwaukee for five minutes?
8. James belongs to a corn club. He raised 75 bu. of corn on one acre which he planted. His expenses were \$0.454 a bushel. He sold 69 bu. at \$1.50 a bushel and 6 bu. of seed corn at \$4.00 a bushel. What was his profit? At the same profit per acre what would be the profit on a 10-acre field of corn?
9. What was the total of each of these purchases?

EDITH'S PURCHASE

2 erasers, \$0.10 each
 1 ruler, \$0.15
 2 ruled notebooks, \$0.10 each
 1 box pen points, \$0.25
 1 penholders, \$0.10 each

VINCENT'S PURCHASE

3 pencils, \$0.05 each
 2 notebooks, \$0.15 each
 1 tablet, \$0.15
 1 eraser, \$0.10
 1 book strap, \$0.30

10. Mr. Williams kept an account of the gasoline he used to run his pleasure car during July and August. His account showed 40 gallons at \$0.33 a gallon, 50 gallons at \$0.34, and 50 gallons at \$0.35. What did the gasoline cost him? How many gallons did he use?
11. If Mr. Williams's car made 15.5 miles on a gallon of gasoline, how many miles did it run? How much is gasoline a gallon where you live? Find out how far some automobile that you know of can be run on a gallon of gasoline.

12. Find the shoe bill for a year for this family:

Father $\left\{ \begin{array}{l} 2 \text{ pairs new shoes at } \$6.50 \\ 2 \text{ pairs, half-soled and heeled at } \$2.25 \end{array} \right.$

Mother $\left\{ \begin{array}{l} 2 \text{ pairs new shoes at } \$7.00 \\ 2 \text{ pairs, half-soled and heeled at } \$2.25 \end{array} \right.$

Boy $\left\{ \begin{array}{l} 4 \text{ pairs new shoes at } \$5.00 \\ 4 \text{ pairs, half-soled and heeled at } \$2.00 \end{array} \right.$

Girl $\left\{ \begin{array}{l} 3 \text{ pairs new shoes at } \$5.00 \\ 3 \text{ pairs, half-soled and heeled at } \$1.75 \end{array} \right.$

13. What was your shoe bill for the past year?

14. Milch cows should be fed each day 2.25 lb. of hay or its equivalent for each 100 lb. of their live weight. How much hay should a cow weighing 800 lb. be fed each day?

15. John's father earns \$5.50 a day. How much will he earn during the working days of October, if the first day of October is Tuesday?

How to Divide a Decimal by an Integer.

$$1. \quad .6 \div 2 = \frac{.6}{2} = \frac{.60}{2} = .3. \quad \text{Check: } 2 \times .3 = .6.$$

$$2. \quad .48 \div 6 = \frac{.48}{6} = \frac{.480}{6} = .08. \quad \text{Check: } 6 \times .08 = .48.$$

$$3. \quad .048 \div 6 = \frac{.048}{6} = \frac{.0480}{6} = .008. \quad \text{Check: } 6 \times .008 = .048.$$

In example 1, compare the number of decimal places in the dividend with the number in the quotient. Do the same for examples 2 and 3.

If the divisor is an integer, there are as many decimal places in the quotient as there are in the dividend.

In practice divide in examples 1, 2, and 3 this way:

$$\begin{array}{r} 2 \overline{) .6} \\ .3 \end{array}$$

$$\begin{array}{r} 6 \overline{) .48} \\ .08 \end{array}$$

$$\begin{array}{r} 6 \overline{) .048} \\ .008 \end{array}$$

DIVIDING A DECIMAL BY AN INTEGER

Copy and write the quotients; check:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1.	$2)\underline{6.4}$	$3)\underline{8.4}$	$4)\underline{9.6}$	$5)\underline{7.5}$	$6)\underline{9.6}$
2.	$5)\underline{7.20}$	$6)\underline{4.86}$	$7)\underline{.147}$	$8)\underline{25.6}$	$9)\underline{.108}$
3.	$6)\underline{.042}$	$8)\underline{58.4}$	$6)\underline{3.24}$	$5)\underline{2.4}$ (Write 0 after .4)	
4.	$5)\underline{.38}$	$5)\underline{9.2}$	$6)\underline{5.7}$	$6)\underline{.75}$	$6)\underline{8.7}$
5.	$8)\underline{5.2}$	$4)\underline{.26}$	$4)\underline{4.2}$	$8)\underline{.6}$ (Write 00 after .6)	
6.	$4)\underline{.3}$	$4)\underline{.5}$	$6)\underline{.33}$	$8)\underline{9.2}$	$8)\underline{2.2}$
7.	$9)\underline{.018}$	$9)\underline{.27}$	$9)\underline{2.7}$	$9)\underline{.027}$	$8)\underline{1.4}$
8.	$7)\underline{.035}$	$7)\underline{3.5}$	$7)\underline{.35}$	$8)\underline{4.2}$	$8)\underline{5.8}$
9.	$12)\underline{9.6}$	$12)\underline{.012}$	$12)\underline{.132}$	$12)\underline{1.44}$	$15)\underline{2.25}$
10.	$25)\underline{.025}$	$25)\underline{1.25}$	$25)\underline{6.25}$	$25)\underline{.875}$	$25)\underline{1.025}$
11.	$8)\underline{\$1.68}$ \$	$8)\underline{\$9.60}$ \$	$8)\underline{\$9.92}$ \$	$9)\underline{\$9.90}$ \$	$9)\underline{\$13.50}$ \$
12.	$5)\underline{4}$ (Think of 4 as 4.0)	$5)\underline{2}$	$5)\underline{3}$	$25)\underline{12}$	
13.	$25)\underline{5}$	$25)\underline{10}$	$25)\underline{15}$	$25)\underline{20}$	$15)\underline{6}$
14.	$8)\underline{6}$ (Think of 6 as 6.00)	$4)\underline{3}$	$8)\underline{2}$	$25)\underline{16}$	

Dividing Numbers by 10, 100, and 1000.

1. $.06 \div 10 = \frac{6}{100} \div 10 = \frac{6}{1000} = .006.$

2. $.6 \div 100 = \frac{6}{10} \div 100 = \frac{6}{1000} = .006.$

3. $6 \div 1000 = \frac{6}{1000} = .006.$

In 1, 2, and 3 observe the position of the decimal points in the dividend and in the quotient.

Moving the decimal point one place to the left divides the number by 10, moving it two places to the left divides by 100, moving it three places to the left divides by 1000.

DIVIDING BY 10, 100, AND 1000

Read examples 1-9, naming at sight the quotients; check:

1. $5 \div 10$ (Say .5) 2. $25 \div 100$ (Say .25) 3. $36 \div 1000$ (Say .036)

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
4. $7 \div 10$	$9 \div 10$	$15 \div 10$	$25 \div 10$
5. $.5 \div 10$	$.4 \div 10$	$2.5 \div 10$	$7.5 \div 10$
6. $.25 \div 10$	$.75 \div 10$	$5.6 \div 10$	$.38 \div 10$
7. $9 \div 100$	$1 \div 100$	$12 \div 100$	$75 \div 100$
8. $30 \div 100$	$80 \div 100$	$50 \div 100$	$70 \div 100$
9. $200 \div 1000$	$60 \div 1000$	$25 \div 1000$	$75 \div 1000$

10. A grocer advertised coffee in 10-pound lots at \$4.50. How much was that a pound?

11. 1 hundredweight is 100 lb.; 465 lb. = 4.65 hundredweight. Change each of these weights to hundredweight:

425 lb.

560 lb.

732 lb.

244 lb.

12. The average weight of the hogs sold at Kansas City market day was 227 lb. How many hundredweight is that?

13. James received \$1.20 for 100 lb. of old iron. How much was that a pound?

DIVIDING BY INTEGERS ENDING IN ONE OR MORE ZEROS

Observe carefully the position of the decimal point in examples 2, and 3, and then how the quotient is found.

Divide:

1. $6.3 \text{ by } 30.$

$$\begin{array}{r} 30 \overline{) 63} \\ \underline{.21} \end{array}$$

2. $.84 \text{ by } 20.$

$$\begin{array}{r} 20 \overline{) .084} \\ \underline{.042} \end{array}$$

3. $6.4 \text{ by } 200.$

$$\begin{array}{r} 200 \overline{) 64} \\ \underline{.032} \end{array}$$

In example 1 we may think $6.3 \div 10 = .63$, and $.63 \div 3 = .21$.

Divide in examples 4–8 as in examples 1, 2, and 3; check:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
20 $\overline{) 4.2}$	30 $\overline{) 5.4}$	40 $\overline{) 8.4}$	40 $\overline{) .76}$	50 $\overline{) 2.5}$
50 $\overline{) .75}$	50 $\overline{) .85}$	60 $\overline{) 18.6}$	60 $\overline{) 1.86}$	70 $\overline{) 2.17}$
200 $\overline{) 3.2}$	200 $\overline{) 4.6}$	300 $\overline{) 66}$	(A whole number may be thought of as having a decimal point after units)	
200 $\overline{) 6}$	500 $\overline{) 25}$	500 $\overline{) 27.5}$	600 $\overline{) 18.6}$	800 $\overline{) 24.8}$
20 $\overline{) \$16}$	20 $\overline{) \$24}$	30 $\overline{) \$54}$	40 $\overline{) \$6.40}$	50 $\overline{) \$4.50}$

A grocer advertised coffee in 20-lb. lots at \$8.80; in 30-lb. lots at \$12.90; in 40-lb. lots at \$16.80; and in 50-lb. lots at \$20.50. What was the price of 1 lb. when this coffee was bought in lots of:

1. 20 lb.? 10. 30 lb.? 11. 40 lb.? 12. 50 lb.?

3. A bushel of bran means 20 pounds of bran; state at sight how many bushels of bran there are in lots of the following weights:

20 lb. 280 lb. 360 lb. 500 lb. 1000 lb.

Dividing United States Money by Cents or by Dollars and Cents. To divide \$1.35 by \$0.05, express each as a number of cents and divide; thus:

$$\begin{array}{r} 5 \overline{)135} \\ 27 \end{array}$$

Divide:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1. \$0.05) <u>\$1.85</u>	\$0.07) <u>\$1.75</u>	\$0.12) <u>\$1.44</u>	\$0.25) <u>\$6.25</u>
2. \$0.25) <u>\$8.75</u>	\$1.10) <u>\$4.40</u>	\$1.25) <u>\$5.00</u>	\$2.50) <u>\$7.50</u>
3. \$.01) <u>\$3.50</u>	\$.13) <u>\$6.50</u>	\$1.25) <u>\$8.75</u>	\$0.17) <u>\$9.52</u>

PROBLEMS

1. Fred owned a calf which gained 43.2 lb. in 24 days. What was the average gain per day?
2. Mrs. Brown paid \$1.95 for 3 lb. of sirloin steak. How much was that a pound?
3. Four boys bought a tennis net for \$9.52 and shared the cost equally. How much did each pay?
4. Susan's bill for 10 music lessons was \$15. How much did she charge per lesson?
5. If the plumber charges your father \$3.30 for working from 9 A.M. till noon, how much is he charging per hour?
6. Howard has a flock of 20 chickens. The feed for them for one year cost him \$52.80. The cost of the feed averaged how much per chicken?
7. In one month Howard's hens laid 336 eggs. How many dozen did they lay that month? He received \$21 for the eggs. How much was that a dozen?
8. How much did the cost of the feed Howard bought (see example 6) average per month? How much less than the price he received for the eggs (see example 7)?

Bills. If goods are not paid for when purchased, the dealer sends a *bill* to the purchaser or to the one for whom the goods were purchased. Read the following bill.

SCOTT, HALLIBURTON & CO.

Importers and Dealers in
Dry Goods and General Merchandise

410 North Main St.

Oklahoma City, Okla., March 1, 1921

Sold to Miss Grace D. McCarthy,
1137 North Kline St.

Feb.	23	3 balls yarn	0.55	1 65		
	24	1½ yd. ribbon	0.50	75		
	25	1 middie tie		1 00		
		1 crochet needle		1 00		
		3½ yd. satin ribbon	0.40	1 40	5 80	
RECEIVED PAYMENT						
MARCH 3, 1921						
SCOTT, HALLIBURTON & CO.						

Where and when were the goods sold? By whom and to whom were they sold? Name the quantities of the goods sold, the prices, and the amount of the bill. Go over the multiplications and additions to see that no mistake was made.

1. A bill is *footed* by adding the cost of the different items to find the total cost. Is the footing of this bill correct?

2. A bill is *receipted* by the dealer or some one representing him. This is done by writing *Paid* or *Received Payment*, together with the date and the dealer's name. Who receipted this bill? On what date was it receipted? Why keep the receipted bill?

MAKING OUT BILLS

Rule bill forms and on them make out bills for the following articles. Supply suitable dates. Use your own name for that of the buyer, and the name of some one who deals in the article purchased for that of the seller. Find the cost of all the separate articles in each bill; foot and receipt it.

1.

3	Christmas tree balls	10¢
2	tubes paint	15¢
4	crayon pencils	5¢

2.

2	yd. lace	12
3	birthday cards	15
2	boxes doll's beads	20

3.

2	rolls lunch paper	5¢
6	lunch boxes	2½¢
1	glass peanut butter	18¢
2	boxes ginger snaps	15¢

4.

12	tennis balls	60
4	tennis rackets	\$8.00
1	tennis net	7.50
2	backstop nets	6.00

5.

2	pennants	75¢
1	middie blouse	\$3.50
2	ties	1.50
2½	yd. ribbon	48¢
¾	yd. lace	40¢

6.

1	coat sweater	11.00
2	baseball bats	1.00
2	baseballs	1.00
2	pr. worsted hose	2.00
2	fielder's gloves	9.00

7.

(For a dress for Betsy, age 17)		
3½	yd. serge	\$3.00
⅞	yd. belting	16¢
1	doz. snap fasteners	10¢
1¼	yd. tan linen	60¢
12	ornamental buttons	3¢

8.

(For a dress for Mary, age 11)		
4½	yd. gingham	7.00
1	spool cotton	1.00
1	doz. white pearl buttons	2.00
½	yd. white piqué	7.00
1	card white snaps	1.00

BILLS

TO THE TEACHER. If possible, some of the children should get blank bill forms at dry goods stores, others at hardware stores, others at grocery stores, and so on. They should ask about prices and then study the forms and make others like them, filling them in appropriately, using their own names as those of the purchasers and using current prices.

1. Make out a bill for the following articles, using your name for the purchaser, your grocer's name for the dealer. Use his prices in making out this bill: 2 lb. granulated sugar; 2 cans tomatoes; $\frac{1}{2}$ doz. eggs; $\frac{3}{4}$ lb. cheese; 2 loaves bread.

2. Each girl in the class make out a bill for the material which must be bought for a serviceable dress for herself.

3. Each boy in the class make out a bill for these articles for himself, taking prices from the daily newspapers: 1 suit clothes; 1 pair shoes; 4 pairs socks; 1 cap; 1 sweater.

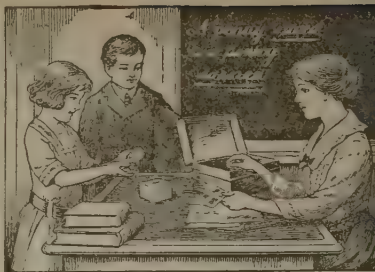
4. Suppose you and five members of your class are to have a picnic lunch and you are selected to buy what is needed; make out a bill for five articles and find how much of the bill each should pay if they share the amount of it equally.

5. When the plumber makes out his bill for labor for small jobs, does he charge by the day or by the hour? How much does he charge where you live? Make out a plumber's bill for 3 hours' work repairing the kitchen sink. How does the carpenter make his charge? How much does he charge? Make out a carpenter's bill for $7\frac{1}{2}$ hours' work repairing the roof.

6. Ask at home to be shown receipted bills, and if convenient bring some of them to class. If you live in a town, get laundry bills and notice the prices; get gas bills, telephone bills, electric light bills, and read carefully what is printed on them.

7. If you live in the country make out a bill for three articles that a farmer might sell to a grocer.

Thrift. Book One contained three letters from Uncle Sam to all his children. He continues his interest in you and is still urging you to be thrifty. He has asked one of his older nephews, Thrifty Jack, to write each of you a letter; here is the letter:



DEAR COUSIN:

The other day I was talking to Uncle Sam and he said to me, "Jack, I certainly am proud of all my school children, nephews and nieces, for the way they helped me out when the great war was on. They sold Liberty Bonds, Thrift Stamps, War Savings Stamps, made gardens, saved food. Now they should like them to do for themselves. I want them to keep right on saving money, not for my sake but for their own. There are so many things they will want money for. Some will want to go to college; some will wish to travel; others will want money to start them in business. The only way they can have it is to save now and keep right on saving. Of course, if they want to lend it to me, they can buy War Savings Stamps and I'll pay them interest on their money and give it back to them in five years or sooner if they need it. How much do you suppose they could save during their vacation?"

So I told Uncle Sam that I believed you could each save at least a dollar and perhaps some of you could save more.

THRIFTY JACK

PROBLEMS

1. Read this newspaper item: "During November 1194 pupils of Sharswood School saved over \$700, most of which came out of the tiny earnings and scant allowances of youngsters whose average age runs hardly above twelve years, some mere tots."

2. How much did you save last summer? What did you do with your savings?

3. What does a thrift stamp cost? What do 10 thrift stamps cost? 16 thrift stamps?

4. How many thrift stamps are required to fill a thrift card?
5. How much money have you saved if you have just enough to buy stamps to fill a thrift card? to fill a thrift card and buy four more thrift stamps?
6. Andrew saves enough to buy thrift stamps sufficient to fill a thrift card every two months. How much does he save in a year?
7. Mr. Lawrence's three children each saved enough money last year to buy enough stamps to fill a thrift card. How much did each save?

PROBLEMS

Uncle Sam told you in his second letter (Book One, page 151) that when you have affixed sixteen 25-cent thrift stamps to your thrift card, you can change it for a war savings stamp by paying from 12 to 23 cents, according to the month. Thus, *Jan.*, 12¢; *Feb.*, 13¢; and so on to *Dec.*, 23¢.

1. What does a war savings stamp cost in each month?
2. If you buy one war savings stamp each month for a year, what will the 12 stamps cost?

In his third letter to you (Book One, page 238) Uncle Sam told you that the war savings stamp, for which you paid \$4.00 and a few cents, will in five years be worth \$5.00. It is worth \$5.00 on the first of January of the fifth year after the one in which it was bought.

3. If you bought a war savings stamp in January of last year, when can you receive \$5.00 for it? When, if you bought it last February?
4. If you bought a war savings stamp last March and one last April, what did you pay for the first? What did you pay for the second? When can you get \$5.00 for each?

A war savings *certificate* has spaces for twenty war savings stamps; the stamps placed thereon should be of the same year's issue.

5. Antonio's older brother bought with his savings sufficient war savings stamps last January to fill a certificate. What will his filled certificate be worth in 5 years? When can he receive this money?

6. Kathryn could buy a coat sweater for herself for \$22.00; but as she can knit one as good and save money, she decided to use her spare time and knit one for herself. She used 24 balls of yarn costing \$0.40 a ball, and spent 40 hours making her sweater.

(a) How much money did she save?

(b) How much did she save for each hour that she worked?

PROBLEMS

1. Philip has a paper route on which he delivers each week the following:

45 evening papers, six deliveries per week, profit $\frac{4}{3}$ ¢ each.

24 weekly magazines, profit 2¢ each.

16 monthly magazines, four deliveries, profit 3¢ each.

What are his earnings from this paper route in 12 weeks?

2. Last year Lillian took the trolley to and from school each day twice a day. She used school tickets which cost 4¢ each. She attended school 193 days. How much did she spend for trolley fare?

3. This year Lillian decided to walk home from school noon and afternoons (see example 2). If she does so and attends as many days as she did last year, how much will she save?

4. If Lillian, on entering the fifth grade, always walks to and from school until she enters high school, how much will she save if her average yearly attendance is 187 days and she is advanced one grade each year?

5. How many school tickets did Lillian use last year (see example 2)? She bought these in books of 25 tickets each. D

he use more than 30 books? If she bought 31 books, did she use all the tickets in the last book? If not, how many had she remaining?

6. George helps his neighbor, Mr. Stevenson, prepare vegetables for market. He is paid \$0.30 an hour. He keeps a record of the number of hours he works each week and presents his bill at the end of each week. Here is the number of hours his record shows for eight weeks. How much did he earn in that time?

$4\frac{1}{2}$ $6\frac{3}{4}$ $7\frac{3}{4}$ 6 $6\frac{1}{4}$ $7\frac{1}{2}$ $7\frac{1}{2}$ $6\frac{3}{4}$

Make out George's bill for the second week.

7. In which week did George earn most (see example 6)? In which week did he earn least?

8. In George's best week he earned how much more than in his poorest week (see example 6)?

9. Out of his earnings, as found in example 6, George bought war savings stamps in August and spent the rest for his vacation. How much did he spend for his vacation?

ACCURACY AND SPEED TESTS

Time yourself to see how long it takes you to get the right answers in each test of this exercise.

Test 1

Test 2

Test 3

$\frac{1}{7} + \frac{3}{7}$ 1. $.7 - .34$ 1. $\$1 + 1 \text{ d.} + 1 \text{¢}$

$\frac{5}{8}$ of 1 dozen 2. $\frac{4}{7} + \frac{5}{7}$ 2. $.40 \div 5$

$\frac{1}{2} \div 5$ 3. $.3 \times .2$ 3. $\frac{5}{9} + \frac{1}{9}$

$\frac{4}{5} - \frac{2}{5}$ 4. $\frac{7}{10} - \frac{3}{10}$ 4. $\frac{3}{8} \div 1\frac{1}{4}$

$.2 + .02$ 5. $\frac{3}{8} \times \frac{5}{12}$ 5. $\frac{4}{5} - \frac{7}{10}$

Test 4

1. $\$0.10 \div 10$
2. $5 - 2\frac{2}{3}$
3. $4 \div 1\frac{1}{2}$
4. $\frac{7}{8} + \frac{7}{8}$
5. $.4 \div 5$

Test 5

1. $2 \div \frac{1}{2}$
2. $4\frac{1}{4} - \frac{5}{8}$
3. $10 \times \$0.01$
4. $\frac{7}{12} + \frac{5}{6}$
5. $5 \times 3\frac{1}{3}$

Test 6

1. $.03 \times 30$
2. $6\frac{1}{2} - 2\frac{5}{8}$
3. $12\frac{1}{2} \div 3$
4. $\$1.10 \div 10$
5. $\frac{1}{4} + \frac{7}{12}$

Test 7

1. $.1 \times 100$
2. $\frac{3}{4} \times 5$
3. $\frac{3}{4} \div \frac{9}{10}$
4. $10 \times .002$
5. $\frac{4}{5} + \frac{5}{6}$

Test 8

1. $8\frac{1}{2} \div 2\frac{1}{2}$
2. $.03 \times 3$
3. $\frac{1}{6} + \frac{3}{10}$
4. $2\frac{1}{3} \times \frac{1}{2}$
5. $3\frac{1}{2} \times 2\frac{1}{4}$

Test 9

1. $3 \times \frac{7}{9}$
2. $3 + 2.1$
3. $.02 - .002$
4. $\frac{3}{5} \div 2$
5. $1 \div \frac{1}{3}$

Test 10

1. $8 \div 12$
2. $.8 - .25$
3. $2 \times \frac{4}{7}$
4. $\$2 - \0.15
5. $\frac{1}{3}$ of $4\frac{1}{2}$

Test 11

1. $.87 - .4$
2. $\frac{1}{2}$ of $.6$
3. $4 - 3.2$
4. $.01 \times 400$
5. $6\frac{2}{5} \div \frac{2}{5}$

Test 12

1. $12\frac{1}{2} \div 1\frac{1}{4}$
2. $\$5 + \0.25
3. $\$2 \div \0.10
4. $.2 + .002$
5. $\frac{3}{5} \div \frac{1}{3}$

REVIEW PROBLEMS

1. Find the cost of 9 grapefruit at \$1.20 a dozen.
2. How many hair ribbons $1\frac{1}{4}$ yd. long can be cut from a b of ribbon 10 yd. long?
3. Divide at sight each of the following by 10; by 100; 1000: 30, 75, 600 lb., \$16, 456, \$250.
4. Which is more: $\frac{3}{4}$ of 30 or $\frac{2}{3}$ of 40? How much more?
5. Joe's brother works 8 hours a day for the first 5 work days of a week and 4 hours on Saturday. How many hours d

work each week? What are his earnings per week if he is paid \$0.80 an hour?

6. Compare each number or amount in the first line below with each number or amount under it in the second. State and prove whether or not the two are equal.

$\frac{1}{2}$	5.0	6	.2	$\frac{\$1}{8}$	$\frac{4}{5}$	$\frac{\$3}{4}$	$37\frac{1}{2}\%$
5	50	6.0	$\frac{1}{5}$	$12\frac{1}{2}\%$	.4	75¢	$\frac{\$3}{8}$

7. For a period of time Mr. Wanamaker offered to sell any of the goods in his stores at 20¢ off on every dollar's worth purchased. What would he then charge for a \$5 hat? For a \$6 pair of shoes? For a \$1.50 tie?

8. Henry's father allowed him to plant and care for the home garden and to have one half of the produce for his work. He raised 24 bunches early onions, 8 qt. early peas, 192 ears sweet corn, 7 pk. string beans, 8 qt. lima beans. How much money did Henry make from his garden if he sold his share at these prices: onions, 10¢ a bunch; peas, 20¢ a pint; sweet corn, 25¢ a dozen; string beans, 25¢ a half peck; lima beans, 25¢ a pint?

9. A carpenter who receives \$1.00 an hour for a day's work of 8 hr. and $1\frac{1}{2}$ times as much per hour for overtime (time and half time) earns how much in a day when he works 9 hr.? 10 hr.?

10. Mr. Sims paid \$9.70 for two pairs of shoes, one pair for James at \$5.25 and one pair for Elizabeth. What did he pay for Elizabeth's shoes? How much more for James's than for Elizabeth's?

11. In three events in an athletic contest the Everett and the McKinley high schools made the best records. Tell which won these events and by how much:

	100-YARD DASH	RUNNING BROAD JUMP	HIGH JUMP
Everett:	11.2 seconds	17.7 feet	5.3 feet
McKinley:	11.6 seconds	18.3 feet	5.5 feet

CHAPTER IV

MEASURES

You have learned and used in Book One most of the tables measures in everyday use. If you have forgotten, or cannot find any of them with certainty, in the examples of pages 118-120 find the table at the end of this book and learn it.

REVIEW OF LIQUID MEASURES

1. How many gills are there in a pint? pints in a quart? quarts in a gallon?
2. Write the table of liquid measure, using proper abbreviations.
3. Name the part of a pint in each: 1 gi.; 2 gi.; 3 gi.
4. A pint is what part of a quart?
5. Name the part of a gallon in each: 1 qt.; 2 qt.; 3 qt.
6. Reduce to pints: 2 qt.; $2\frac{1}{2}$ qt.; $3\frac{1}{2}$ qt.; 2 qt. 1 pt.
7. Reduce to quarts: $\frac{1}{2}$ gal.; $2\frac{1}{2}$ gal.; $4\frac{1}{2}$ gal.; 2 gal. 2 qt.
8. How many quart bottles are required to hold 4 gal. milk? What is the milk worth at \$0.16 a quart?
9. How many pint bottles are required to hold a gallon cream? What is the cream worth at \$0.30 a pint?
10. A measure called a *barrel* is $31\frac{1}{2}$ gal. How many quarts are there in a barrel?
11. A measure called a *hogshead* holds 2 barrels (bbl.). How many gallons are there in a hogshead?

12. Find the cost of 5 gal. of gasoline at \$0.35 a gallon.
13. Bring to class a list of five different kinds of liquids that are sold by any of the measures named in the table, and the prices at which they are sold.
14. What use have you ever had for these measures?

REVIEW OF DRY MEASURES

1. How many pints are there in a quart? quarts in a peck? pecks in a bushel?
2. Write the table of dry measure, using proper abbreviations.
3. Name the part of a peck in each of the following: 1 qt.; 2 qt.; 5 qt.; 2 qt.; 4 qt.; 7 qt.; 6 qt.
4. Name the part of a bushel in each of the following: 1 pk.; 2 pk.; 3 pk.; 2 pk.
5. Reduce to quarts: $\frac{1}{2}$ pk.; $2\frac{1}{2}$ pk.; $\frac{3}{4}$ pk.; $2\frac{1}{4}$ pk.
6. Reduce to pecks: $\frac{1}{2}$ bu.; $3\frac{1}{2}$ bu.; $\frac{3}{4}$ bu.; $4\frac{1}{4}$ bu.
7. How many pecks are there in 8 qt.? 12 qt.? 16 qt.? 20 qt.?
8. How many bushels are there in 8 pk.? 10 pk.? 12 pk.? 16 pk.? 18 pk.?
9. How many pecks and quarts are there in 20 qt.? 26 qt.? 30 qt.? 36 qt.?
10. How many bushels and pecks are there in 6 pk.? 10 pk.? 14 pk.? 30 pk.?
11. Andrew's father took $\frac{1}{2}$ bu. of raspberries to market, selling them in pint boxes at \$0.20 a box. How much did he receive for them?
12. When potatoes are selling at \$0.20 a half peck, how much will 3 half pecks cost? that a peck? a bushel?

13. Potatoes are usually sold by weight, a bushel meaning 60 pounds of potatoes. How many pounds of potatoes should be given for a half bushel? a peck? a half peck?

14. How much is saved by buying a half bushel of sweet potatoes for \$1.50 instead of the same quantity, a half peck at a time, at \$0.50 a half peck?

15. Bring to class a list of five articles that are sold by dry measures and the prices at which they are now sold where you live.

16. What use have you ever had for dry measure?

REVIEW OF MEASURES OF WEIGHT—POUNDS AND OUNCES

1. How many ounces are there in 1 pound? $\frac{1}{2}$ pound? $\frac{1}{4}$ pound? $\frac{3}{4}$ pound? $\frac{1}{8}$ pound? $\frac{3}{8}$ pound? $\frac{5}{8}$ pound?

2. What is the abbreviation for *ounce* or *ounces*? *pound* or *pounds*?

3. Name the part of a pound in each of the following: 1 oz. 8 oz.; 4 oz.; 2 oz.; 12 oz.; 6 oz.; 10 oz.; 14 oz.; 9 oz.

4. How many pounds and ounces are there in 20 oz.? 24 oz. 36 oz.? 50 oz.?

5. What is the cost of 4 oz. of candy at \$0.80 a pound?

6. Helen bought 10 cents' worth of crackers. They were 20 a pound. How many ounces did she receive?

7. When a 2-ounce package of tea sells for 10¢, how much is that a pound?

8. At \$0.80 a pound what is the cost of 8 oz. of dried beef 12 oz.? 14 oz.?

9. Janet paid \$0.22 for a 2-pound bag of flour. She told her mother what a barrel of flour would cost at this rate. What would it cost? (A barrel of flour weighs 196 lb.)

10. Sara bought a box of cocoa which weighed $\frac{1}{4}$ lb. net (which means that the weight of the box or other container is not considered). How many ounces of cocoa did she buy, and what was the price per pound if she paid 12¢ for the box of cocoa?
11. Find the cost of 1 lb. 4 oz. of cheese at \$0.32 a pound.
12. What did Ruth's mother pay for a dressed chicken weighing $3\frac{3}{4}$ lb. at \$0.60 a pound?
13. Bring to class a list of five articles which can be bought by the ounce and five which can be bought by the pound, and the prices at which they are sold.
14. Write the table of weight.

MEASURES OF WEIGHT—TONS AND HUNDREDWEIGHTS

1. Name some articles that are sold by the ton (T.).
 2. When your father buys a ton of coal from the dealer, how many pounds should he receive?
 3. In Pennsylvania a ton of coal means 2240 lb. (a long ton). How many pounds of coal should a man receive who buys $2\frac{1}{2}$ T. Pennsylvania? $3\frac{1}{2}$ T.?
 4. How many 100-pound bales of hay will make a ton?
 5. What is the cost of 100 lb. of hay at \$32 a ton? 3000 lb.? 100 lb.?
 6. A truck that has a capacity of 15,000 lb. (that is, can carry a load of this weight) has a capacity of how many times 1000 lb.? How many tons?
- 100 pounds is sometimes called a *hundredweight* (cwt.). Shipments on railroads are frequently charged for by the hundredweight, and in some states grains, potatoes, and some other commodities are sold by the hundredweight.

7. What is the cost of shipping 280 lb. of sporting goods if the rate is \$1.10 per 100 lb.?

SUGGESTION. $280 \text{ lb.} = 2.8 \times 100 \text{ lb.}$

8. Mr. Simonds bought from a grain dealer 700 lb. of oats at \$1.50 a hundredweight and 400 lb. of barley at \$1.68 $\frac{1}{2}$ a hundredweight. How much was his grain bill?

9. What is the cost of shipping 480 lb. of dry goods at \$1.20 per 100 lb.?

10. What must your grocer pay for 500 lb. of potatoes at \$2.50 a hundredweight?

11. When potatoes are selling at \$1.80 a bushel (60 lb.), what is the price per pound? What is the price per 100 lb.?

12. A bushel of bran means 20 *pounds* of bran. How many bushels of bran weigh 1000 lb.?

13. What is the cost of 275 lb. of bran at \$1.25 per 100 lb.?

14. A bushel of wheat means 60 *pounds* of wheat. What is 630 lb. of wheat worth at \$1.40 a bushel? at \$1.96 per 100 lb.?

15. Daniel's father bought 1000 lb. of flour in 5-lb. sacks at \$5.60 per 100 lb. and sold it at \$0.40 a sack. What was his profit?

16. Find out what it would cost to ship a 2400-lb. automobile from your shipping point to Chicago.

REMARK. For weights of grain, seeds, and other produce see page 280.

REVIEW OF MEASURES OF TIME

1. Give orally the table for measuring time.
2. Write the table of time, using proper abbreviations.
3. Write the names of the days of the week and opposite each name write its abbreviation. Be sure that you spell these correctly.

4. Examine carefully a calendar for this year; make a list of the months; write opposite each the abbreviation used for it, and the number of days it contains. Thus, *January, Jan., 31 da.*
5. What does 8.45 A.M. mean? 4.00 P.M.? 7.30 P.M.?
6. Anna's school opens at 9.00 A.M. If she walks from home to school in 20 min., how late may she leave home and yet be at school on time?
7. Jesse's older brother works each week day from 7.30 A.M. to 11.30 A.M. and from 12.30 P.M. till 4.30 P.M. He earns \$75 an hour. What are his daily wages?
8. If Jesse's older brother quits work at 11.30 A.M. Saturday morning (see example 7) and loses no time earlier in the week, what are his wages for a week?
9. A train that leaves Boston at 2.00 P.M. Monday, and makes the run to Cleveland in 17 hr., should reach Cleveland when?
10. Reduce to seconds: $\frac{3}{4}$ min.; .4 min.; .9 min.; $1\frac{1}{4}$ min.
11. Reduce to minutes: $1\frac{1}{2}$ hr.; $\frac{3}{4}$ hr.; 75 sec.; .5 hr.; 1 hr. 15 min.
12. Reduce to hours: $1\frac{1}{4}$ da.; $\frac{5}{8}$ da.; .75 da.; 1 da. 8 hr.
13. Reduce to days: $1\frac{1}{2}$ wk.; $\frac{2}{7}$ wk.; 2 wk. 4 da.; $1\frac{3}{7}$ wk.
14. Reduce to years and months: 20 mo.; 30 mo.; 40 mo.; 34 mo.

PROBLEMS—MEASURES OF TIME

1. What is Mrs. Britton's rent bill for a year if she pays \$42 a month?
2. On the corner-stone of a school building is the number MCMXX. What year does this represent?
A short way of writing the date, July fourth, 1922, is *July 4, 1922.*
3. Write the date of your birth; the date on which you will be 16 years old; 21 years old.

4. Why is July 4, 1776, a date of interest to us? Is that date more than a hundred years ago? Is it two hundred years ago? Who can find out how many years from July 4, 1776, to July 4 this year?

5. Eleanor practices her music lesson 1 hr. 20 min. in the morning and 40 min. in the afternoon. How long does she practice each day? each week (6 da.)?

6. If the nurse is to give the patient a certain kind of medicine every two hours beginning at 8.30 A.M. until she has given him 6 doses, at what times should she give the medicine, and when should she cease giving it?

7. If a watch which is set correct gains 12 seconds a day, how many minutes and seconds too fast is it in a week?

8. The President of the United States is elected in years whose number is divisible by 4. When will the next President be elected the one following the next?

9. Find out what name is given to a year in which February has 29 days. When will such a year next occur? Will it be the year in which our President is elected?

REVIEW OF MEASURES OF LENGTH

1. Draw a line which you think is 6 inches long. Test. If your estimate was not correct, make the line just 6 inches long. To express the length of this line you used *1 inch* as the *unit of measure*.

2. What *unit of measure* do you use to express the length of the schoolroom? the height of a building?

3. Estimate the length and width of this room. Write your estimates on paper, then test them. If they were not correct, find out how much they were too long or too short. Who in class made the closest estimate to the correct length? Who made the closest estimate to the correct width?

4. What is used as the *unit of measure* in selling such articles as ribbon, lace, and gingham?
5. Bring to class to-morrow a list of four articles which you have seen advertised for sale by the yard and the prices at which they were advertised.
6. How many inches are there in a foot? feet in a yard? inches in a yard?
7. What part of a yard is 1 ft.? What part of a yard is 2 ft.? ft.?
8. What are the divisions of the inches on your foot rule?
9. Complete the following:
 $1\text{ in.} = \frac{1}{12}\text{ ft.}$ $2\text{ in.} = \frac{1}{6}\text{ ft.}$ $3\text{ in.} = \dots\text{ ft.}$ $4\text{ in.} = \dots\text{ ft.}$
 $5\text{ in.} = \dots\text{ ft.}$ $6\text{ in.} = \dots\text{ ft.}$ $7\text{ in.} = \dots\text{ ft.}$ $8\text{ in.} = \dots\text{ ft.}$ $9\text{ in.} = \dots\text{ ft.}$
10. Estimate the heights of different members of your class. Write the estimates on paper, and then take turns testing. Who made the greatest number of correct or nearest correct estimates? Who is the tallest? Who is the shortest?
11. What did Marion pay for $\frac{3}{4}$ yd. ribbon at 60¢ a yard, and yd. lace at 80¢ a yard?

PROBLEMS — MEASURES OF LENGTH

1. Cut from a stout cord a piece $5\frac{1}{2}$ yd. long. With the aid of another pupil stretch it tight before the class and tell them another name for this length.
2. If the cord (example 1) is divided into *foot lengths*, as nearly possible, how many foot lengths will it make, and how much over?
3. Express in three ways the length of the cord described in example 1.
4. A mile is 320 times as long as the cord described in example 1. How many yards are there in a mile? how many feet?

5. A convenient measure to use in measuring a mile is a strong cord 4 rd. long. How many feet long is this cord?

6. Knowing the number of feet in a mile (see answer to example 4), and the number of feet in the length of the cord (see answer to example 5), find out how many 4-rod measures are required to make a mile.

7. Starting at a convenient point near your school, measure off $\frac{1}{4}$ of a mile along the road or street that runs past the school.

8. Take 100 steps of uniform length, then measure the distance you have stepped, and find the length of your step. Do the work a second time as a check.

9. Write the table used for measures of length, with proper abbreviations.

10. Change the following to inches: 2 ft.; $\frac{3}{4}$ ft.; .5 ft.; 1 ft. 3 in.; 2 ft. 9 in.; 3 ft. 3 in.; 4 ft. 2 in.

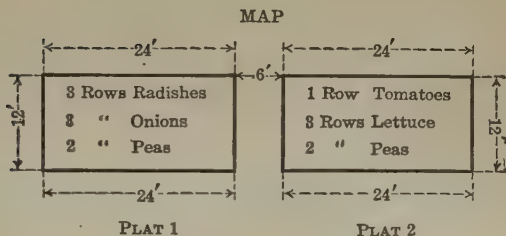
11. Change to feet and inches: 20 in.; 27 in.; 30 in.; 40 in.

12. A *nautical mile*, or a *knot*, is 1.152 common miles; a torpedo boat which ran at the rate of 18 knots an hour for 10 hr. ran how many common miles in that time?

13. There are 3 ft. in a yard and 5.5 yd. in a rod. How many feet are there in a rod?

HOME GARDEN PROJECT—MEASURING TO A SCALE

Plat 1 represents Edward's home garden, and plat 2, Russell's. The map of the gardens and of the walk between them is drawn on a scale of 1 inch to 24 feet (scale $1'' = 24'$), which means that 1 inch on the map represents 24 feet on the ground.



1. Measure carefully each heavy line on the map and the width of the space representing the walk between the plats. Is the map drawn correctly to the scale of 1 inch to 24 feet?
2. Draw plat 1 on a scale of $1'' = 6'$.
3. Draw the map on a scale of $1'' = 12'$.
4. How many feet long is each of the rows shown on the map?
5. Each row of radishes yielded 1 bunch to each foot of row. How many bunches of radishes did Edward raise?
6. Each row of onions yielded 1 bunch to each foot of row. How many bunches of onions did Edward raise?
7. Each row of lettuce yielded 2 heads to each foot of row. How many heads of lettuce did Russell raise?
8. Each row of peas yielded 1 qt. to each 6 ft. of row. How many quarts of peas did each boy raise?
9. Russell's row of tomatoes contained 6 vines and each vine produced an average of 1 pk. of tomatoes. How many pecks of tomatoes did Russell raise?
10. Here are the prices the boys received; fill in the missing numbers and find how much money each boy made from his garden:

EDWARD

RUSSELL

- | | |
|-----------------------------------|--|
| . bunches radishes, per bunch, 5¢ | . . . pecks tomatoes, per half peck, 50¢ |
| . bunches onions, per bunch, 8¢ | . . . heads lettuce, per head, 8¢ |
| . quarts peas, per pint, 20¢ | . . . quarts peas, per pint, 20¢ |

REVIEW OF SQUARE MEASURE

1. Draw the following on the same sheet of paper and bring to class:

- A square 1 in. long (1-in. square).
- A square 2 in. long (2-in. square) divided into square inches.
- A square 3 in. long (3-in. square) divided into square inches.
- A square 4 in. long (4-in. square) divided into square inches.

2. How many square inches are there in the 1-in. square? the 2-in. square? the 3-in. square? the 4-in. square?

3. Each of the following indicated products gives the *size* or *area* of one of the squares in example 1; tell which one:

$$3 \times 3$$

$$2 \times 2$$

$$1 \times 1$$

$$4 \times 4$$

4. Tell at sight the number of square inches in a 5-in. square; a 6-in. square; a 10-in. square; a 12-in. square.

5. Draw on a blackboard a square a foot long and divide it into square inches. How many square inches does a square foot contain?

6. Draw on a blackboard a square a yard long and divide it into square feet. How many square feet does a square yard contain?

7. Multiply $5\frac{1}{2} \times 5\frac{1}{2}$. The product is the number of square yards in a square rod. What is the number?

8. At some convenient place on or near the school ground measure off a square a rod long. There are 160 sq. rd. in an acre.

Learn this table:

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards	= 1 square rod (sq. rd.)
160 square rods	= 1 acre (A.)

9. How many square feet are there in a 2-ft. square? a 5-ft. square? a 10-ft. square? a $\frac{1}{2}$ -ft. square?
10. How many square yards are there in a square 2 yd. long? 3 yd. long? 10 yd. long? $2\frac{1}{2}$ yd. long?
11. If you know the number of inches or feet or yards in the length of a square, how do you find the number of square inches, square feet, or square yards in the square?

FINDING THE AREAS OF RECTANGLES

1. In one corner of a sheet of paper draw a square inch. On the same sheet draw a rectangle 3 in. long and 2 in. wide and divide it into square inches.
2. Show your teacher the rectangle you drew for example 1. How many square inches does it contain? The product of what two numbers tells you this?
3. What *unit* did you use to express the *size*, or *area*, of the rectangle of example 1?
4. Draw on the blackboard a rectangle 3 ft. long and 2 ft. wide. Divide it into square feet. How many square feet does the rectangle contain? The product of what two numbers tells you this?
5. What unit did you use to express the *size*, or *area*, of the rectangle in example 4?

The length and width of a rectangle are called its dimensions.

6. What are the dimensions of the rectangle in example 1? in example 4?

Before attempting to find the size or area of a rectangle be sure that the dimensions are expressed in terms of the same unit; for example, both in inches or feet or yards.

7. If the dimensions of a rectangle are expressed in inches what unit do you use to express its size or area? if they are expressed in feet? if they are expressed in yards?

8. What two numbers may you multiply together to tell quickly the area of a rectangle 5 in. long and 2 in. wide? 6 ft. long and 3 ft. wide? 4 yd. long and 3 yd. wide? 6 yd. long and $1\frac{1}{2}$ yd. wide?

The area or the number of square units in a rectangle equals the number of units in the length times the number of units in the width.

PROBLEMS—MEASURES OF RECTANGLES

1. Draw rectangles of the following dimensions, representing an inch by $\frac{1}{2}$ of an inch. This is called *drawing to a scale of $\frac{1}{2}$* . Find the areas of the rectangles:

*a**b**c**d*

6 in. and 4 in. 6 in. and 2 in. 8 in. and 6 in. 10 in. and 8 in.

5 in. and 4 in. 5 in. and 3 in. 7 in. and 5 in. 10 in. and 7 in.

2. How many square yards are there in a piece of oilcloth 5 yd. long and 2 yd. wide?

3. How many square feet are there in the ceiling of a room 20 ft. long and 16 ft. wide?

4. If the floor of your schoolroom is in the form of a rectangle, measure its length and width and find how many square feet it contains.

5. How many square feet are there in Edward's home garden (page 127)? How many square feet in Russell's? How many in the walk between the gardens?

6. A blotter 8 in. long and $3\frac{3}{4}$ in. wide contains how many square inches?

7. How many square rods are there in a lot 10 rd. long and 4 rd. wide? What part of an acre does it contain?

8. Knowing the number of square rods in an acre and the number of square yards in a square rod, how can you find the number of square yards in an acre? Find the number.

9. Some farmers estimate a step or pace to be 1 yd. A farmer who estimates in this way set off in his field a rectangular piece of land 121 steps long and 40 steps wide. How much land did the piece contain, if his steps averaged 1 yd.?

10. How many blotters 6 in. long and $3\frac{1}{2}$ in. wide can be cut without waste from a sheet of blotting paper 2 ft. long and 14 in. wide?

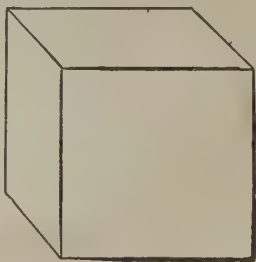
REVIEW OF CUBIC MEASURE

As you have already studied the cube and the rectangular solid (see Book one, pages 254-257), this exercise and the next are intended mainly as a review of these two important figures.

1. Measure the edges of a cube and tell how they compare in length.

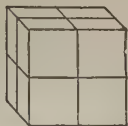
2. Measure one of the front edges of this picture of a cube and tell how long it is.

A cube 1 inch long is a 1-inch cube and contains 1 cubic inch.



3. What is meant by a 2-in. cube?

4. How many 1-in. cubes can be placed in a cubical box 2 in. long?



SUGGESTION. Study the figure opposite. Think of each small cube as representing a 1-in. cube.

5. How many 1-in. cubes can be placed in a cubical box 3 in. long?

6. How many cubic inches are there in a 4-in. cube?

7. What *unit of measure* did you use to express the *size or volume* of the cubes in examples 4, 5, and 6?

8. Which of the following indicated products gives the surface area or volume of the cube in example 4? in example 5? in example 6?

$$2 \times 2 \times 2$$

$$3 \times 3 \times 3$$

$$4 \times 4 \times 4$$

9. A 1-foot cube is how many inches long? how many inches wide? how many inches high? How many cubic inches does it contain?

10. A cube 1 yd. long is how many feet long? how many feet wide? how many feet high? How many cubic feet does it contain?

Learn this table:

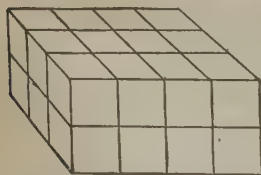
1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.)

27 cubic feet

= 1 cubic yard (cu. yd.)

11. How many cubic inches are there in a rectangular solid 4 in. long, 3 in. wide, and 2 in. high?

SUGGESTION. How many cubic inches are there in 1 row along the front edge? How many cubic inches are there in 1 layer of cubes? How many



layers of cubes are there in the rectangular solid? How many cubic inches does it contain? What does the product of $2 \times 3 \times 4$ tell?

12. What *unit of measure* did you use in example 11?

13. How many cubic feet of sand will a box hold that is 4 ft. long, 3 ft. wide, and 2 ft. high? What *unit of measure* do you use to express the number? What numbers may you multiply together to find the answer in a short way?

The number of cubic units in a rectangular solid equals the number of units in the height, times the number of units in the width, times the number of units in the length.

REMARK. Before attempting to find the number of cubic units in a rectangular solid, be sure to express the length, the width, and the height (*dimensions*) in terms of the same unit.

14. How many cubic feet of air are there in a room 40 ft. long, 9 ft. wide, and 10 ft. high?
15. How many cubic inches does a vessel hold that is 11 in. long, 1 in. wide, and 3 in. high? The answer is the number of cubic inches in a gallon. How many cubic inches does a gallon contain?
16. A bushel of wheat is about $\frac{5}{4}$ cu. ft. How many bushels of wheat will a box hold that is 5 ft. long, 3 ft. wide, and 4 ft. high?
17. A load of earth is estimated to be a cubic yard. How many loads of earth must be removed in digging a cellar for a house 12 ft. long and 18 ft. wide, if the cellar is dug to a depth of 9 ft.?

ADDITION

1. Add, expressing any sum of 16 oz. or over as *lb.*, or *lb.* and *oz.* Thus say or write, 3 *lb.* for 48 oz. Say or write 1 *lb.* 10 oz. for 19 oz. Add as many as possible at sight.

oz.	14 oz.	10 oz.	14 oz.	8 oz.	7 oz.	10 oz.
oz.	10 oz.	12 oz.	12 oz.	12 oz.	9 oz.	9 oz.
oz.	<u>2 oz.</u>	<u>8 oz.</u>	<u>9 oz.</u>	<u>8 oz.</u>	<u>15 oz.</u>	<u>12 oz.</u>

2. Add, expressing any sum 12 in. or over as *ft.*, or *ft.* and *in.* and as many sums as possible at sight.

in.	8 in.	11 in.	9 in.	6 in.	9 in.	11 in.
in.	9 in.	10 in.	8 in.	5 in.	9 in.	10 in.
in.	<u>6 in.</u>	<u>4 in.</u>	<u>11 in.</u>	<u>10 in.</u>	<u>9 in.</u>	<u>8 in.</u>

3. Mary mailed three Christmas packages; one weighed 2 lb. 3 oz., one 1 lb. 6 oz., and one 1 lb. 10 oz. What was the weight of the three?

- oz. Add the numbers that stand for ounces. Think 1 *lb.* 3 oz. for 19 oz.
- 3 Write 3 under *oz.* and below the line; add 1 to the *lb.* column.
- 6 Add the numbers (including 1) that stand for pounds.
- 10 Write 5 under *lb.* and below the line. What is the sum?

Add:

	<i>lb.</i>	<i>oz.</i>		<i>ft.</i>	<i>in.</i>		<i>gal.</i>	<i>qt.</i>		<i>bu.</i>
4.	6	4	5.	3	6	6.	4	2	7.	2
	3	8		2	9		6	1		1
	4	6		4	8		2	3		5

SUBTRACTION

1. Mrs. Taylor bought a 10-pound bag of sugar and used 4 oz. for preserving and the remainder for the table. How much of it did she use for the table?

lb. *oz.* Write the weights as here shown.

10 Change 1 lb. of the 10 lb. to ounces.

6 4 Then subtract the numbers that stand for ounces.

Write 12 under *oz.* and below the line.

Subtract 6 from 9. (Why not from 10?)

Write 3 under *lb.* and below the line. Prove your answer.

Subtract:

	<i>lb.</i>	<i>oz.</i>		<i>bu.</i>	<i>pk.</i>		<i>hr.</i>	<i>min.</i>		<i>ft.</i>
2.	12		3.	10		4.	7		5.	16
	4	8		4	3		2	45		7

6. Clara left home at 4.45 one afternoon to visit May. returned at 7.15 P.M. How long was she away?

hr. *min.* *Think:* 45 is more than 15.

7 15 Change 1 hr. of the 7 hr. to minutes and add 60 to 15.

4 45 Then subtract the numbers that stand for minutes.

Write 30 under *min.* and below the line.

Complete the work as in problem 1. *Check.*

Subtract:

	<i>lb.</i>	<i>oz.</i>		<i>ft.</i>	<i>in.</i>		<i>lb.</i>	<i>oz.</i>		<i>hr.</i>
7.	8	12	8.	8	2	9.	7	4	10.	9
	3	4		5	10		3	12		7

1. The 12-year-old record for standing broad jump at the Jackson School is 7 ft. 3 in. Earl jumped 6 ft. 9 in. How much less the record was he? Fred jumped 5 ft. 11 in. How much less the record was he?

2. Rose raised 8 qt. of lima beans. She donated 2 qt. 1 pt. to the home hospital and sold the remainder at \$0.20 a pint. How much money did she receive?

MULTIPLICATION

To finish Henry's room the paperhanger found that he needed 4 pieces of molding each 2 ft. 9 in. long. If he used a piece 12 ft. long in making and fitting them, how much of the molding was waste?

in. Multiply the number that stands for inches first.

9 *Think:* 36 in. = 3 ft.

4 Multiply the number that stands for feet.

Add 3 to the product. (Be sure to multiply the number that stands for feet *before* you add 3.)

Write the sum under *ft.* and below the line.

What is the product?

Multiply:

<i>gal.</i>	<i>qt.</i>	<i>bu.</i>	<i>pk.</i>	<i>ft.</i>	<i>in.</i>	<i>lb.</i>	<i>oz.</i>
3	2	3. 4	2	4. 5	3	5. 6	8
	4		6		8		4

Mrs. Wilson bought 4 packages of rolled oats, each containing 3 lb. 7 oz., net. What was the weight of the four packages?

oz. Multiply the number that stands for ounces first.

7 *Think:* 28 oz. = 1 lb. 12 oz.

4 Write 12 under *oz.* and below the line.

Multiply the number that stands for pounds.

Add 1 to the product.

Write the sum under *lb.* and below the line.

What is the product?

Multiply:

<i>gal.</i>	<i>qt.</i>	<i>bu.</i>	<i>pk.</i>	<i>ft.</i>	<i>in.</i>	<i>lb.</i>
7. 3	2	8. 4	3	9. 6	4	10. 5
	6		5		7	

DIVISION

1. Ellen's mother sold 4 dressed chickens which together weighed 13 lb. 8 oz. What was their average weight?

<i>lb.</i>	<i>oz.</i>	
4)13	8	Divide the number that stands for pounds first. Write 3 under <i>lb.</i> and below the line. <i>Think: 1 lb. over = 16 oz.</i>

Add 16 and 8. Divide the number that now stands for ounces; that is, $16 + 8$, and write the quotient under *oz.* and below the line.

What is the answer? Check by multiplying the answer by 4. What should the product be?

Divide:

<i>gal.</i>	<i>qt.</i>	<i>ft.</i>	<i>in.</i>	<i>lb.</i>	<i>oz.</i>	<i>hr.</i>	<i>min.</i>
2. 2)6	2	3. 5)14	2	4. 4)15	12	5. 6)10	
<i>bu.</i>	<i>pk.</i>	<i>ft.</i>	<i>in.</i>	<i>hr.</i>	<i>min.</i>	<i>lb.</i>	<i>oz.</i>
6. 5)12	2	7. 6)14	6	8. 6)19	36	9. 8)26	

10. Philip stepped a distance of 23 ft. 4 in. in 10 steps. What was the average length of his step?

11. Find out, as Philip did, what is the average length of your step.

12. The heights of the boys on the basket ball team at Andre's school are 5 ft., 4 ft. 11 in., 5 ft., 4 ft. 10 in., and 4 ft. 11 in. What is their average height?

GENERAL REVIEW

1. Read: Iowa dairies yield about \$143,000,000 a year.
2. Read: The distance of the moon from the earth is about 238,000 miles. The distance of the sun from the earth is about 93,000,000 miles.
3. How many of the first eight examples of page 38 can you work in five minutes?
4. How do you check the result in addition? Illustrate.
5. In working examples 9-20, page 38, how many correct answers can you get in four minutes?
6. How do you check the result in subtraction? Illustrate.
7. How many of the sixteen examples in multiplication on page 39 can you now work in six minutes?
8. How do you check the result in multiplication? Illustrate.
9. What is a short way of multiplying an integer by 10? by 100? by 1000?
10. In the following name the products at sight; if you cannot do so, make a list of those which you cannot name and learn them: 2×3 , 4×4 , and so on to 25×25 .
11. How many of the sixteen examples in division on page 39 can you now work in eight minutes?
12. How do you check the result in division when there is no remainder? when there is a remainder? Illustrate each.

Name the sums, then the differences:

$\frac{5}{8}$	$3\frac{1}{2}$	$2\frac{1}{3}$	$4\frac{3}{4}$	$4\frac{3}{4}$	.7	.45	.12	.3	7 in.
$\frac{1}{8}$	$2\frac{1}{2}$	$2\frac{1}{6}$	$1\frac{1}{4}$	$3\frac{1}{2}$	.2	.3	.04	.03	5 in.

14. $\begin{array}{r} 3 \text{ ft. } 10 \text{ in.} \\ 1 \text{ ft. } 2 \text{ in.} \end{array}$ $\begin{array}{r} 18 \text{ hr.} \\ 6 \text{ hr.} \end{array}$ $\begin{array}{r} 2 \text{ gal. } 3 \text{ qt.} \\ 1 \text{ gal. } 2 \text{ qt.} \end{array}$ $\begin{array}{r} 2 \text{ lb. } 8 \text{ oz.} \\ 1 \text{ lb. } 8 \text{ oz.} \end{array}$ $\begin{array}{r} 2 \text{ hr. } 40 \text{ m.} \\ 1 \text{ hr. } 20 \text{ m.} \end{array}$

15. $\begin{array}{r} 37\frac{1}{2}\text{¢} \\ 12\frac{1}{2}\text{¢} \end{array}$ $\begin{array}{r} 66\frac{2}{3}\text{¢} \\ 33\frac{1}{3}\text{¢} \end{array}$ $\begin{array}{r} \frac{7}{8} \text{ lb.} \\ \frac{1}{4} \text{ lb.} \end{array}$ $\begin{array}{r} 1.75 \text{ oz.} \\ .5 \text{ oz.} \end{array}$ $\begin{array}{r} 87\frac{1}{2}\text{¢} \\ 12\frac{1}{2}\text{¢} \end{array}$ $\begin{array}{r} \$0.75 \\ \$0.25 \end{array}$ $\begin{array}{r} \$1.50 \\ \$0.50 \end{array}$

16. Write six fractions each equal to $\frac{1}{2}$; to $\frac{3}{4}$.

17. Name the fractions of the following list which are not in lowest terms, and express them in lowest terms:

$\frac{8}{12}$ $\frac{4}{9}$ $\frac{12}{10}$ $\frac{7}{15}$ $\frac{16}{12}$ $\frac{8}{24}$ $\frac{6}{4}$ $\frac{9}{16}$ $\frac{16}{9}$

18. Which of the fractions in example 17 are proper fractions?

19. Look at each number in the first line and state whether it is greater than, equal to, or less than, the number below it in the second line. If it is greater, state how much greater; if less, how much less.

$\frac{2}{3}$.5 1.0 $\frac{16}{25}$ 1.2 .6 $\frac{1}{2}$ $\frac{2}{3}$ $\frac{2}{5}$.2
 $\frac{4}{9}$ $\frac{1}{2}$ 1 $\frac{4}{5}$ $1\frac{1}{5}$ $\frac{3}{5}$.50 $\frac{9}{4}$ $\frac{4}{25}$ $\frac{1}{2}$

20. Name the inverse of each of these numbers:

$\frac{3}{4}$ $\frac{1}{2}$ 3 $\frac{2}{3}$ $\frac{5}{4}$.5 $2\frac{1}{2}$ $3\frac{1}{3}$ 1 7

21. What is the product of any number and its inverse? Illustrate your answer by using five illustrations.

22. Name the missing numbers:

$6 \div \frac{2}{3} = 6 \times ?$ $\frac{1}{2} \times 8 = 8 \div ?$ $6 \div 5 = 6 \times ?$ $8 \div \frac{1}{5} = 8 \times ?$

23. Name the products; check:

$2 \times \frac{3}{16}$ $2 \times 2\frac{1}{2}$ $3 \times 3\frac{1}{3}$ $2 \times .2$ $10 \times .1$ $7 \times \frac{1}{7}$
 $3 \times \frac{2}{7}$ $4 \times 1\frac{1}{4}$ $4 \times 2\frac{1}{2}$ $2 \times 12\frac{1}{2}$ $4 \times 12\frac{1}{2}$ $8 \times \frac{1}{8}$

24. Name the quotients; check:

$\frac{8}{9} \div 4$ $\frac{2}{3} \div 3$ $.6 \div 2$ $.6 \div 10$ $1 \div \frac{1}{4}$ $2 \div \frac{1}{2}$
 $1 \div \frac{3}{4}$ $3 \div \frac{3}{4}$ $2\frac{1}{2} \div 2$ $2\frac{1}{2} \div 1\frac{1}{4}$ $5 \div 2\frac{1}{2}$ $2\frac{1}{2} \div \frac{1}{2}$
 $3 \div 4$ $4 \div 3$ $\frac{1}{2} \div \frac{1}{4}$ $\frac{1}{4} \div \frac{1}{2}$ $.1 \div 10$ $\$0.80 \div .08$

25. Find the sums; then the differences; check:

$\frac{5}{10}$	$\frac{3}{8}$	$\frac{11}{12}$	$\frac{11}{12}$	$\frac{2}{3}$	$\frac{4}{9}$	$4\frac{1}{2}$
<u>$\frac{3}{10}$</u>	<u>$\frac{1}{4}$</u>	<u>$\frac{1}{4}$</u>	<u>$\frac{3}{4}$</u>	<u>$\frac{5}{8}$</u>	<u>$\frac{5}{12}$</u>	<u>$3\frac{7}{8}$</u>

26. Find the products; check:

$\frac{1}{4}$	$\frac{2}{3} \times \frac{1}{5}$	$\frac{1}{2} \times \frac{3}{4}$	$\frac{2}{3} \times \frac{4}{5}$	$\frac{2}{3} \times \frac{3}{5}$	$\frac{2}{9} \times \frac{5}{6}$
$\frac{6}{5}$	$\frac{4}{5} \times \frac{15}{8}$	$2\frac{1}{2} \times 4$	$2\frac{1}{2} \times 2\frac{1}{2}$	$.3 \times .4$	$.3 \times .04$

27. Find the quotients and check answers:

$-\frac{1}{3}$	$\frac{2}{3} \div \frac{5}{4}$	$\frac{2}{3} \div \frac{5}{8}$	$\frac{7}{8} \div \frac{3}{4}$	$\frac{3}{4} \div \frac{7}{8}$	$\frac{9}{10} \div \frac{9}{15}$
$-\frac{14}{5}$	$\frac{5}{18} \div \frac{2}{9}$	$\frac{5}{6} \div \frac{5}{9}$	$\frac{5}{9} \div \frac{5}{6}$	$3\frac{3}{4} \div 1\frac{1}{2}$	$3\frac{3}{4} \div 7\frac{1}{2}$

28. Divide each of the following by $\frac{5}{2}$; by $\frac{5}{4}$:

5	6	8	10	12	15	25	50
---	---	---	----	----	----	----	----

29. Does $10 \div \frac{5}{2} = 10 \times \frac{2}{5}$? Why?

30. Does $10 \div \frac{5}{2} = 10 \times .4$? Why?

31. Does $10 \div \frac{5}{4} = 10 \times \frac{4}{5}$? Why?

32. Does $10 \div \frac{5}{4} = 10 \times .8$? Why?

33. Can you work example 28 in a short way? (See examples 29 and 32.)

34. The divisor is 3 and the quotient 789. What is the dividend?

35. The divisor is 3, the quotient 56, and the remainder 2. What is the dividend?

36. The divisor is 6 and the quotient $3\frac{1}{2}$. What is the dividend?

37. What is a short way of dividing a whole number ending in 0 by 10?

38. $1000 \div 100 = ?$ $5600 \div 100 = ?$ $1,000,000 \div 1000 = ?$

39. Express as hours: 90 min.; 75 min.; 45 min.; 100 min.

40. How many dozen are there in 100?

41. Who said, "Fourscore and seven years ago our father brought forth on this continent a new nation"? How many years ago was this statement made? To what year did the speaker refer and to what event?

42. At a play festival a girl sold 4 gal. of ice cream in half-pint boxes. How many boxes did she use?

43. A crate of Southern strawberries was sold at 45¢ a box. The crate contained six layers of boxes; in each layer there were two rows of four boxes each. How much was received for the strawberries?

44. Postage stamps are printed in sheets of 100 each. What must be paid for 2 sheets of 2-cent stamps and one sheet of 1-cent stamps?

45. At the rate of 10¢ for 40 clothespins, find the cost of 5 doz.

46. What will it cost to express a package weighing 160 lb., at the rate of \$1.50 per 100 pounds?

47. How many seconds are there in one minute and a quarter?

48. Andrew lives $\frac{3}{4}$ mi. from school and walks this distance four times a day. How far does he walk in going to and from school in a school month of 20 days? in a school year of $9\frac{1}{2}$ mo.?

49. If a 6-lb. roast of beef cost \$1.92, how much did the beef cost a pound? If it was served to ten people, what was the average cost of one portion?

50. A dressed fowl was bought at \$0.60 a pound; it weighed $3\frac{3}{4}$ lb. What did it cost?

51. If the average length of William's step is 24 in., how many steps does he take in walking $\frac{1}{4}$ mi.?

52. On a certain day there was but 1.4 hr. sunshine at Boston out of a possible 11.9 hr. sunshine. For how many hours of the day was the sun obscured at Boston?

53. Scratch feed for poultry was sold by a dealer in 5-lb. sacks for 35¢, in 10-lb. sacks for 65¢, and in 100-lb. sacks for \$5.90. What was the price per pound at each of the prices quoted?

54. What was paid per pound for baby chick feed when a $2\frac{1}{2}$ -lb. package costs 35¢?

55. The normal yield of raspberries is 2500 qt. to the acre. If this yield was sold at 10¢ a pint, how much was received for them? Find out what is meant by *normal yield*.

56. In a recent drive to raise funds for the Salvation Army there were collected in one of our largest cities in three days 84,915 pennies, 63,308 nickels, 43,967 dimes, and 27,152 quarters. This collection contained how many pieces of money? What was the amount of the collection?

57. What does Mrs. Hill save by buying a bushel of potatoes (60 lb.) for \$1.20 instead of in 5-lb. lots at 3¢ a pound?

58. Mr. Witmer sold 10 head of steers averaging 1030 lb. each at \$0.13 a pound. How much did he receive for them?

59. A cubic foot of bin space holds about .8 bu. of grain. How many bushels of grain will a bin hold if its dimensions are 8 ft., 6 ft., and 4 ft.?

60. A quart of early tomatoes that cost 40¢ in a city market in the North was bought from the producer in the South for 8¢. The producer received what part of the amount which the purchaser paid?

61. The window space for a bedroom should be at least $\frac{1}{10}$ of the floor space. What is the least window space which a bedroom should have if it is 20 ft. long and 16 ft. wide? Test your bedroom to find out if it has sufficient window space.

62. At 30¢ a square foot, find the cost of laying a cement walk 8 ft. long and 2 ft. 6 in. wide.

63. Grace has 12 thrift stamps on her thrift card. How many more does she need to fill it? How much will they cost? When her thrift card is filled, how much additional must she pay when she exchanges it for a war savings stamp in June?

64. In a running broad jump John made the best record, 17 ft. 1 in. Henry's record was 16 ft. 8 in., and Allen's 15 ft. 10 in. John's record was how much better than Henry's? How much better than Allen's? Henry's was how much better than Allen's?

65. A newsboy, when asked what he paid for an evening paper which he was selling for 2¢, replied that he paid 4¢ for 3 papers. How much did he pay for each, and what were his profits for 6 days' sales, if his average daily sales were 210 papers?

66. Mrs. Smith can buy tomatoes at 15¢ a can or by the case of 2 doz. cans for \$3.45. How much will she save by buying a case rather than 2 doz. cans one at a time?

67. Mrs. Adams bought a pail of mackerel, net weight 10 lb. for \$1.95. How much was that a pound?

68. A rule followed in setting telephone poles is to set a pole 40 ft. long 6 ft. in the ground, and increase the depth 6 inches for each additional 5 ft. in the length of the pole. How deep in the ground should a telephone pole be set whose length is 45 ft. 60 ft.? 50 ft.?

69. Five pounds of Bordeaux lead makes 50 gal. of spray (used for potato blight, potato bug, apple codlin moth, and cabbage worm). This quantity of spray will cover one acre. A farmer wishes to spray $\frac{2}{5}$ of an acre of potatoes. How many pounds of Bordeaux lead should be used, and how much spray should he make?

70. The speedometer on Mr. Weaver's automobile registered 46.8 mi. at the beginning of a trip and 217.6 mi. at the end. What was the distance traveled per hour if the trip was made in 6 hr.?

71. The money received from the sale of refreshments at a lay festival is here shown. Write these amounts in the columns at the right in a form which you rule, and find the total.

	DOLLARS	CENTS
Pennies, 2425		
Nickels, 1726		
Dimes, 421		
Quarters, 176		
Halves, 82		
Bank notes:		
Ones, 56		
Twos, 12		
Fives, 6		
Tens, 1		
Total		

72. At \$0.24 a pound, find the cost of two hams, one weighing 4 lb. 9 oz. and the other 13 lb. 11 oz.

73. If \$0.25 is the cost of 1 pound, 1 yard, 1 piece, or 1 package of anything, how many pounds, yards, pieces, or packages can be bought for

\$1.25? \$3.25? \$4.75? \$5.50? \$8.25? \$12.25?

74. A family whose income is \$2340 a year (52 weeks) has what income per week? A family with this income should spend not more than \$829.40 for food for the year and \$304.20 for clothing. How much does this allow for food for a week? How much for clothing?

75. The gross gain made by a pig at the Ohio Experimental Station was 2.1 lb. per day for a period of 105 days. The pig weighed 87 lb. at the beginning of the period. What did it weigh at the end of the period?

PART TWO

CHAPTER I

FUNDAMENTAL OPERATIONS

Specific Aims. During this year you should strive to attain a high standard of efficiency in arithmetical work. This means that you should (1) obtain a thorough knowledge of the processes of arithmetic with integers, fractions, and decimals; (2) acquire skill and power in the use and application of these processes; and (3) acquire a usable knowledge of facts and affairs associated with practical arithmetical problems.

Use of Large Numbers. The growth of this country in the development of its resources and in its productions and industries has been so rapid and on so vast a scale as to require in recent years a constant use of large numbers. They appear with frequency in newspapers and magazines. These numbers run up into tens of billions and sometimes beyond.

It is not unusual to hear the word *billion* used. During the war we often spoke of Liberty Loans which were for billions of dollars; yet few have any realization of the meaning of a number so large. Only through some such illustration as the following can one even begin to have an understanding of what a billion means: The Treasury Department, Washington, D. C., states that a million dollar-bills weigh about 2900 pounds; a *billion* dollar-bills weigh 2,900,000 pounds and to haul them all at one time, 725 trucks would be required, each loaded with two tons of these bills.

READING AND WRITING LARGE NUMBERS

Hundred-billions 2	Ten-billions 4	Billions 8,	Hundred-millions 3	Ten-millions 5	Millions 6,	1	0	8,	5	2	0
Billions 4th period			Millions 3d period			2d period			1st period		

1. Name in order from right to left the periods that come before millions; all the places in these periods.
2. Read the names of the third and fourth periods.
3. Name all the places in the third and fourth periods of the table. Read the number in the table.
4. How many million make a billion?
5. Read: The Salvation Army distributed more than 2,000,000 pounds of coal in one year to needy persons.
6. Read: 1,000,000,000; 10,000,000,000; 100,000,000,000.
7. Read this statement recently published in a magazine: "Remember that the dairy industry of the United States is a \$2,000,000,000 affair; that the great American cow produces about 90,000,000,000 pounds of milk a year; that about 45,000,000,000 pounds is manufactured into other products; that the dairies and creameries of this country turn out more than 1,500,000,000 pounds of butter a year." Find out which state in the Union leads in the production of milk; butter; cheese.
8. Write, using figures: The debt of the United States after the World War was over, was 26 billion dollars; that of France, over 34 billion dollars; and that of Germany, about 40 billion dollars.

9. Write, using figures: It is estimated that the wealth of the United States is 220 billion dollars.

10. Find in newspapers or periodicals four numbers like those in examples 5 to 8. Write them on the blackboard to-morrow and tell how they were used.

ADDITION — ACCURACY AND SPEED TESTS

1. Here are 20 of the most difficult of the 45 elementary combinations in addition; try to name all the sums in 15 seconds:

8	9	5	9	7	9	7	8	9
<u>7</u>	<u>4</u>	<u>3</u>	<u>9</u>	<u>4</u>	<u>3</u>	<u>6</u>	<u>3</u>	<u>6</u>
6	8	6	7	8	7	8	9	8
<u>5</u>	<u>6</u>	<u>4</u>	<u>3</u>	<u>8</u>	<u>5</u>	<u>4</u>	<u>7</u>	<u>5</u>

2. In adding a number of one figure to a number of two figures, the combinations are more difficult than others. These are given in examples 2 to 10. In how much less than 90 seconds can you name all the sums?

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
2.	19	48	59	28	68	88	79	59	28
	<u>9</u>	<u>8</u>	<u>6</u>	<u>6</u>	<u>7</u>	<u>7</u>	<u>6</u>	<u>8</u>	<u>8</u>
3.	38	69	99	17	48	39	89	68	99
	<u>7</u>	<u>6</u>	<u>8</u>	<u>7</u>	<u>6</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>
4.	49	58	48	19	78	59	19	28	79
	<u>9</u>	<u>8</u>	<u>7</u>	<u>6</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>9</u>
5.	98	69	39	88	18	39	89	99	98
	<u>7</u>	<u>9</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>6</u>	<u>8</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
6.	89	79	38	57	47	18	49	69
	<u>8</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>6</u>	<u>6</u>	<u>7</u>	<u>8</u>
7.	97	58	87	79	18	39	58	98
	<u>7</u>	<u>6</u>	<u>9</u>	<u>8</u>	<u>8</u>	<u>9</u>	<u>7</u>	<u>6</u>
8.	97	78	29	38	27	29	59	87
	<u>6</u>	<u>8</u>	<u>7</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>7</u>
9.	88	69	87	17	47	29	77	27
	<u>6</u>	<u>7</u>	<u>6</u>	<u>6</u>	<u>7</u>	<u>9</u>	<u>7</u>	<u>6</u>
10.	67	68	57	19	29	37	78	37
	<u>7</u>	<u>6</u>	<u>6</u>	<u>7</u>	<u>6</u>	<u>7</u>	<u>7</u>	<u>6</u>

Note the record you made in naming the sums in examples 10; then try to beat this record.

ADDITION — ACCURACY AND SPEED TESTS

Try to get the correct answers to 10 of the first 12 of the following examples in 8 minutes. If you cannot, review them frequently and reach this standard as soon as you can. Check results.

1.	2.	3.	4.	5.
958	643	576	997	468
384	328	415	439	725
803	802	248	640	376
461	819	893	218	247
602	891	318	152	323
591	555	150	408	856
627	764	727	563	180
375	377	364	375	514
<u>749</u>	<u>649</u>	<u>996</u>	<u>876</u>	<u>999</u>

8.	9.	10.	11.	12.
375	304	168	429	754
344	143	195	338	477
107	912	201	362	219
942	495	157	110	143
101	329	507	746	508
569	666	393	875	296
965	807	782	257	385
267	587	236	489	628
<u>888</u>	<u>587</u>	<u>689</u>	<u>569</u>	<u>639</u>

Add and check:

3.	14.	15.	16.	17.	18.
5.25	\$923.82	\$293.28	\$179.20	\$759.46	\$753.68
8.46	239.50	362.73	355.43	345.67	967.35
6.96	568.37	976.75	749.37	257.90	823.50
<u>7.42</u>	<u>125.36</u>	<u>187.23</u>	<u>864.25</u>	<u>359.86</u>	<u>739.67</u>

SUBTRACTION — ACCURACY AND SPEED TESTS

These are the most difficult of the 100 possible elementary subtractions. Can you name the differences in less than 30 seconds?

11	16	12	10	11	13	14	12	17
<u>8</u>	<u>8</u>	<u>4</u>	<u>6</u>	<u>4</u>	<u>6</u>	<u>9</u>	<u>3</u>	<u>8</u>
10	11	12	10	13	12	11	15	17
<u>4</u>	<u>2</u>	<u>6</u>	<u>3</u>	<u>9</u>	<u>5</u>	<u>3</u>	<u>6</u>	<u>9</u>
15	11	10	11	13	12	16	14	14
<u>9</u>	<u>5</u>	<u>7</u>	<u>9</u>	<u>8</u>	<u>7</u>	<u>9</u>	<u>8</u>	<u>5</u>
16	11	13	15	12	11	12	14	15
<u>7</u>	<u>6</u>	<u>4</u>	<u>7</u>	<u>8</u>	<u>7</u>	<u>9</u>	<u>7</u>	<u>8</u>

Try to get the correct answers to any 12 of these examples in subtraction in 4 minutes. If you cannot, review them frequently and reach this standard as soon as you can. Check the differences.

2. 172909159 <u>93421630</u>	3. 138599094 <u>73610189</u>	4. 149644097 <u>64051436</u>	5. 101508379 <u>25130458</u>
6. 278754376 <u>179746510</u>	7. 174073189 <u>92549775</u>	8. 626250541 <u>485707280</u>	9. 10240673 <u>653928</u>
10. 116813118 <u>43292635</u>	11. 10378345 <u>7483071</u>	12. 527067253 <u>365861290</u>	13. 8617589 <u>4882726</u>
14. \$4875.75 <u>2786.25</u>	15. \$7050.25 <u>1875.75</u>	16. \$67854.00 <u>27865.25</u>	17. \$9000.0 <u>2785.8</u>

MULTIPLICATION — TESTS AND PRACTICE

1. Time yourself to find how long you require to name all the products in these 40 of the most difficult of the 78 multiplication combinations.

6×3	11×5	8×4	9×5	6×5	9×6	7×7	12×
7×6	12×7	9×4	12×8	8×3	12×4	8×8	12×
12×9	8×6	12×5	6×6	11×4	8×5	12×3	11×
9×8	10×10	9×9	7×5	11×6	12×12	7×4	12×
9×3	11×9	6×4	11×7	9×7	11×8	8×7	11×

In how much less than 6 minutes can you find the products to y 9 of the following 16 examples? Check.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
2.	7395 <u>29</u>	7593. <u>56</u>	3579 <u>74</u>	5793 <u>83</u>	2468 <u>48</u>	6284 <u>39</u>	8462 <u>57</u>	4826 <u>64</u>
3.	4893 <u>38</u>	9483 <u>65</u>	8349 <u>49</u>	3948 <u>27</u>	5726 <u>58</u>	2675 <u>36</u>	6725 <u>72</u>	7256 <u>94</u>

Multiply each of the following by 276; by 348; by 205; by 8; by 809.

4. 2456	5. 3789	6. 7935	7. 8642
8. 5684	9. 9763	10. 8009	11. 7056

Square. The *product* obtained by taking a number twice as a factor is called the *square* of the number.

Thus, the square of 2 is 4, as $2 \times 2 = 4$.

2×2 may be written 2^2 , and is read 2 *squared*.

Cube. The *product* obtained by taking a number three times as factor is called the *cube* of the number.

The cube of 2 is 8, as $2 \times 2 \times 2 = 8$.

$2 \times 2 \times 2$ may be written 2^3 , and is read 2 *cubed*.

FINDING SQUARES AND CUBES AND USING SPECIAL MULTIPLIERS

I. Name at sight the answer to each of the following:

2^2 3^2 4^2 5^2 6^2 7^2 8^2 9^2 2^3 3^3 1^3 4^3

2. Write the squares of all numbers from 10 to 25 inclusive. Try to learn them all by to-morrow.

3. Write the cubes of all numbers from 5 to 10 inclusive.

4. Multiply at sight each of the following by 10 ; by 100 ; by 1000

7	20	25	50	100	250	750	8
---	----	----	----	-----	-----	-----	---

5. Multiply at sight each of the following by 20 ; by 30 ; by 40 ; by 50 :

6	4	9	8	10	30	20	40	50
---	---	---	---	----	----	----	----	----

DIVISION — ACCURACY AND SPEED TESTS

Name the quotients and remainders in the following ; for 1, say : *quotient 7, remainder 2.*

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	
1.	8) <u>58</u>	6) <u>33</u>	7) <u>30</u>	5) <u>28</u>	5) <u>12</u>	9) <u>15</u>	8) <u>30</u>	8) <u>62</u>	7)
2.	7) <u>36</u>	6) <u>40</u>	9) <u>84</u>	8) <u>50</u>	5) <u>18</u>	7) <u>12</u>	8) <u>36</u>	6) <u>15</u>	8)
3.	6) <u>45</u>	8) <u>66</u>	5) <u>42</u>	6) <u>10</u>	8) <u>26</u>	9) <u>40</u>	7) <u>40</u>	6) <u>50</u>	9)
4.	8) <u>38</u>	7) <u>65</u>	5) <u>32</u>	5) <u>9</u>	6) <u>20</u>	8) <u>52</u>	9) <u>33</u>	8) <u>42</u>	6)
5.	9) <u>48</u>	5) <u>48</u>	9) <u>57</u>	8) <u>54</u>	6) <u>28</u>	8) <u>28</u>	9) <u>24</u>	8) <u>60</u>	5)
6.	8) <u>34</u>	5) <u>38</u>	7) <u>25</u>	8) <u>12</u>	7) <u>15</u>	8) <u>46</u>	8) <u>75</u>	8) <u>55</u>	9)

Instead of naming the quotients and remainders in examples 1-6, name the complete quotients. For 1, *a*, say $7\frac{1}{4}$. Be sure that the fractional part of each answer is in lowest terms.

In how much less than 8 minutes can you find the quotient of any 9 of the following 16 examples in division ? Check all results.

7.	27) <u>5535</u>	8.	38) <u>15542</u>	9.	49) <u>39298</u>	10.	56) <u>22</u>
11.	83) <u>22493</u>	12.	94) <u>47564</u>	13.	65) <u>40915</u>	14.	72) <u>43</u>
15.	49) <u>23079</u>	16.	56) <u>45920</u>	17.	27) <u>13257</u>	18.	38) <u>22</u>
19.	65) <u>60955</u>	20.	72) <u>26640</u>	21.	83) <u>25398</u>	22.	94) <u>36</u>

Divide and check. Time yourself on each group of 5 examples.

3. 176,334	by	a. 134	28. 789,321	by	a. 346
4. 876,485		b. 206	29. 867,832		b. 728
5. 900,764		c. 345	30. 700,468		c. 506
6. 820,583		d. 728	31. 800,000		d. 832
7. 745,000		e. 978	32. 900,000		e. 999

Factoring. Finding the numbers which multiplied together will produce a given number is called *factoring*. (See Factors, page 30.)

Prime Number. A number that has no factors other than itself and 1 is a *prime number*.

Thus, 5 is a prime number, since the only factors of 5 are 5 and 1.

Prime Factors. When all the factors of a number are prime numbers, they are called the *prime factors* of the number.

Thus, in $20 = 2 \times 2 \times 5$, the factors being prime numbers are the prime factors of 20.

FACTORING

1. Name two factors which will produce :

9	25	10	15	24	36	48	54	49
64	32	14	28	20	77	84	63	81
30	42	27	18	70	45	56	72	132
16	22	35	40	99	100	120	121	144

2. Name three factors which will produce :

12	27	30	28	50	42	18	64
----	----	----	----	----	----	----	----

3. Name each number of example 1 which is the product of 3 equal factors.

4. Which of the numbers of example 2 can you express as the product of 3 equal factors?

5. Make a list of all the prime numbers that are less than 50.
6. Express each of the numbers in example 1 as the product of its prime factors. Thus, for the first, say or write $12 = 2 \times 2 \times 3$.
7. Numbers which are not prime are sometimes called *composite numbers*. Name all composite numbers that are less than 40.

Divisibility. A number that will divide a given number without a remainder is an *exact divisor*, or simply a *divisor* of the given number. Thus, 6 is a divisor of 12 but not of 13.

Even Number. A number that is divisible by 2 is called an *even number*; as, 6, 8, and 20.

Odd Number. A number that is not divisible by 2 is called an *odd number*; as, 3, 9, and 11.

Some Easy Tests of Divisibility. Illustrate each of the following statements:

1. A number is divisible by 2 if the units' figure is 0, 2, 4, 6, or 8.
2. A number is divisible by 5 if the units' figure is 0 or 5.
3. A number is divisible by 4 if the number expressed by the two right-hand figures is divisible by 4.
4. A number is divisible by 3 if the number expressed by the sum of the digits is divisible by 3.
5. A number is divisible by 9 if the number expressed by the sum of the digits is divisible by 9.

EXACT DIVISORS

1. Name each number of the following list which is divisible by 2 and state the quotient; by 5; by 4; by 3; by 9.

18	25	32	48	54	63	72	84	
100	125	135	140	150	180	200	210	225
369	375	390	400	450	470	480	483	495

1. Name all the numbers which will divide both numbers in following pairs of numbers:

and 18	12 and 18	18 and 24	21 and 28	28 and 42
and 24	24 and 36	20 and 30	32 and 48	48 and 60
and 50	40 and 60	40 and 48	48 and 54	60 and 72

Name the even numbers in examples 1 and 2; the odd numbers.

Cancellation. If John's earnings are 25¢ a day for 4 days each week and it is required to find how many weeks he must work to earn enough to buy 16 thrift stamps costing 25¢ each, the problem is solved by dividing the cost of 16 thrift stamps by his earnings in 1 week.

This is indicated thus: $\frac{16 \times 25}{4 \times 25}$.

The factor 25 is *canceled* $\frac{16 \times \cancel{25}}{4 \times \cancel{25}}$.

The required number, 4, is then found by dividing 16 by 4.

This is a short and easy way to solve many problems involving multiplication and division, and illustrates that:

Crossing out (canceling) the same factor from both dividend and divisor does not change the quotient.

Sometimes it is possible to cancel more than one factor in both dividend and divisor.

Thus, in finding the value of $\frac{6 \times 35 \times 11}{2 \times 15}$, read *6 times 35 times 11 divided by*

2 times 15, we cancel the 2 in the divisor and 2 from the 6 in the dividend, writing the quotient, 3. We next cancel the 3 in the dividend and 3 from the 15 in the divisor, writing the quotient, 5. Then we cancel 5 from the divisor and 5 from the 35 in the dividend, writing the quotient, 7. Then there remain the factors 7 and 11 in the dividend. The product, 77, is the value of the expression.

CANCELLATION

Using cancellation, find the values of the expressions in examples 1-20.

1.

$$\frac{5 \times 18}{6}$$

2.

$$\frac{7 \times 24}{8}$$

3.

$$\frac{5 \times 36}{9}$$

4.

$$\frac{8 \times 15}{5}$$

5.

$$\frac{6 \times 15}{10}$$

6.

$$\frac{9 \times 12}{18}$$

7.

$$\frac{7 \times 10}{14}$$

8.

$$\frac{9 \times 48}{36}$$

9.

$$\frac{10 \times 21}{15}$$

10.

$$\frac{33 \times 12}{22}$$

11.

$$\frac{14 \times 15}{21}$$

12.

$$\frac{18 \times 25}{45}$$

13.

$$\frac{24 \times 56}{28 \times 16}$$

14.

$$\frac{36 \times 35}{14 \times 15}$$

15.

$$\frac{48 \times 45}{36 \times 20}$$

16.

$$\frac{72 \times 55}{33 \times 30}$$

17.

$$\frac{35 \times 54}{5 \times 7 \times 6 \times 9}$$

18.

$$\frac{42 \times 63}{6 \times 9 \times 7 \times 7}$$

19.

$$\frac{45 \times 64}{16 \times 9 \times 5}$$

20.

$$\frac{5 \times 36 \times 8 \times 4}{15 \times 12 \times 6 \times 2}$$

21. How many 5-pound sacks of flour can be made from 6 sacks of flour each containing 140 lb.?

22. How many tons of bran are there in a shipment of 60 sacks each containing 100 lb. of bran?

23. How many yards of gingham at 24¢ a yard should Mr. Grant receive in exchange for 12 doz. eggs at 60¢ a dozen?

24. How many weeks must Mabel's father work to earn enough money to pay his rent for 12 months at \$25 a month, if he earns \$5 a day for 6 days each week?

5. How many dozen pieces of crayon are there in 5 boxes, each containing 144 pieces?
6. If you study your arithmetic lesson 45 minutes every day during the school year of 180 days, how many hours do you study arithmetic during the year? how many days?
7. How many tons (2000 lb.) of hay are there in 80 bales averaging 125 lb. to the bale?

PROBLEMS INVOLVING THE FOUR FUNDAMENTAL PROCESSES

The manager of a boys' baseball team bought 9 sweaters at \$10.95 each and a catcher's mask for \$5.75. How much did he pay for all?

Before solving a problem *estimate*, when possible, the *probable* answer. In problem 1 think: \$10.95 is nearly \$11. $9 \times \$11 = \99 . \$5.75 is nearly \$6. The manager should pay about $\$99 + \6 , or \$105. Then solve the problem and compare your estimate with the answer; thus:

\$95	the cost of 1 sweater
\$9	
\$55	the cost of the 9 sweaters
\$75	the cost of the catcher's mask
\$30	the cost of all

\$105 was the estimate, so the estimate was nearly correct.

TO THE TEACHER. A part or the whole of a recitation should now and be devoted to having the pupils describe in a general way how the problem of an exercise should be solved. Thus, in problem 1: *Multiply \$10.95 and add \$5.75 to the product.*

A charitable organization distributed to poor families during the winter 30 sacks of flour, each containing 40 lb., giving to each family 24 lb. How many families were supplied with this amount?

Counting at the rate of \$5000 an hour, how many hours would be required to count \$1,000,000 in \$1 bills?

4. Four boys bought a boat for \$60, each paying the same amount. After using it for the summer they sold it for \$40. What did the use of the boat cost each boy for the summer?

5. During August Mrs. Williams received 16 deliveries of milk of 3 qt. each, 8 deliveries of 2 qt. each, and 7 deliveries of 1 qt. each. What was her milk bill for that month, the price of milk being 15¢ a quart?

6. What is the average height of four boys whose heights are 64 in., 66 in., 60 in., and 62 in., respectively?

Remember that the average of two or more numbers is found by dividing their sum by the number of numbers added.

7. What is the dividend if the divisor is 25, the quotient is 125, and the remainder 5? Prove your answer.

8. What is the minuend if the subtrahend is 1675 and the difference 1098? Prove your answer.

9. Counting 52 weeks to a year, which is the more pay for a year and how much, \$28 a week, or \$120 a month?

10. When Samuel graduated from the eighth grade at the age of 14, he went to work. At the age of 25 years he had earned \$5112.50. James graduated from high school when he was 18 years old and by the time he was 25 years old he had earned \$7337.50. How much more did James earn than Samuel by the time they were 25 years old, and in how many years less? How much more did James's high school education pay?

11. The population of the United States in 1910 was 91,972,642 and in 1920 it was 105,710,620. What was the increase for the ten years?

12. The regulation step of an American soldier is 30 in. long. When marching at quick time he takes 120 steps per minute. How many feet does he march per minute?

3. Mr. Hudson bought a house for \$8800; he paid \$4000 in cash and expects to pay the remainder of the cost in 15 years, paying the same amount each year. How much must he pay each year? How much should his average monthly savings be to meet these yearly payments?
4. When an aeroplane is flying at a speed of 130 mi. an hour, how far is it flying per minute?
5. Some school boys cut corn for a farmer one Saturday and were paid 8¢ a shock. One of them cut 56 shocks, another 52, and another 48. How much did the three boys earn?
6. There are 1760 yd. in a mile. How many feet are there in a mile? How many inches?
7. A bushel of lime weighs 70 lb. Is a load of 60 bushels of lime more or less than 2 T. and how much?
8. The Salvation Army distributed among the poor families in a town 15 T. of coal of 2000 lb. each, giving to each family 100 lb. How many families received part of this coal?
9. How much is a family paying for coal per ton of 2000 lb. when it is buying it by the bucket of 10 lb. at 15¢ per bucket?
10. A farmer sold his crop of wheat consisting of 15,840 lb. at 10¢ a bushel (60 lb.). How much did he receive for it?
11. If each of the 20,000,000 families of this country wastes one pound of flour a year, how many barrels (196 lb.) do they waste and how many pounds over?
12. The citizens of a town are raising \$5000 for their hospital; at the beginning of a certain day \$3256 had already been collected. During the day three contributions were made of \$25 each, one of \$50, and one of \$75. How much more do they need to raise the \$5000?

CHAPTER II

FRACTIONS

REVIEW

In the following list of numbers :

1. Read the integers; the fractions; the mixed numbers.
2. Read the proper fractions; the improper fractions.
3. Read the fractions that are in lowest terms.
4. Express in lowest terms each fraction that is not in low terms.
5. Express each mixed number as an improper fraction.
6. Express each improper fraction as a whole number or a mixed number, being sure that the fractional part of each mixed number is in lowest terms :

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
$\frac{1}{2}$	$\frac{4}{3}$	$1\frac{1}{2}$	$\frac{6}{8}$	$3\frac{1}{3}$	2	$\frac{10}{4}$
$\frac{8}{10}$	$\frac{9}{8}$	$\frac{9}{4}$	$2\frac{3}{4}$	$\frac{10}{8}$	$\frac{12}{18}$	$\frac{18}{12}$
7	$7\frac{1}{2}$	$6\frac{2}{3}$	$\frac{25}{2}$	$\frac{25}{10}$	$\frac{4}{25}$	$\frac{18}{18}$
$\frac{20}{3}$	$\frac{25}{4}$	$\frac{50}{8}$	$\frac{12}{10}$	$\frac{8}{6}$	$\frac{40}{3}$	$16\frac{2}{3}$
$11\frac{1}{9}$	$\frac{12}{9}$	$\frac{9}{12}$	$\frac{25}{18}$	$\frac{30}{18}$	$\frac{20}{8}$	$\frac{42}{7}$
1	$\frac{16}{32}$	$37\frac{1}{2}$	$\frac{10}{12}$	$\frac{40}{15}$	$\frac{22}{7}$	$33\frac{1}{3}$

7. State at sight the least common denominator of :

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
$\frac{1}{2}$ and $\frac{1}{8}$	$\frac{1}{3}$ and $\frac{3}{10}$	$\frac{3}{4}$ and $\frac{1}{12}$	$\frac{1}{6}$ and $\frac{5}{18}$	$\frac{3}{4}$ and $\frac{2}{3}$	$\frac{3}{4}$ and $\frac{1}{5}$
$\frac{5}{8}$ and $\frac{3}{4}$	$\frac{7}{8}$ and $\frac{2}{3}$	$\frac{7}{8}$ and $\frac{5}{8}$	$1\frac{1}{2}$ and $\frac{3}{8}$	$\frac{7}{12}$ and $\frac{2}{3}$	$\frac{1}{10}$ and $\frac{5}{10}$
$\frac{2}{15}$ and $\frac{3}{10}$	$\frac{4}{5}$ and $\frac{5}{6}$	$\frac{2}{3}$ and $\frac{1}{10}$	$\frac{8}{8}$ and $\frac{3}{5}$	$\frac{7}{10}$ and $\frac{3}{8}$	$\frac{3}{20}$ and $\frac{1}{10}$

. Reduce at sight each pair of fractions in example 7 to fractions having the least common denominator.

Least Common Denominator. When the least common denominator (L. C. D.) of two or more fractions cannot be readily found, as in $\frac{7}{20}$, $\frac{4}{15}$, and $\frac{7}{12}$, it may be found thus:

$20 = 2 \times 2 \times 5$ The L. C. D. must have in it the prime factors of 20 (2, 2, and 5) and the prime factor 3 in 15, which is not one of the prime factors of 20. These prime factors, 2, 2, 5, and 3, include the prime factors in 12 (2, 2, and 3). The product of these prime factors, 2, 2, 5, and 3, is 60, and this is the least number exactly divisible by 20, 15, and 12. It is called their L. C. D.

Addition. To find the sum of $\frac{7}{20}$, $\frac{4}{15}$, and $\frac{7}{12}$:

$\frac{7}{20} = \frac{21}{60}$ If you cannot readily see by what number both terms of $\frac{7}{20}$ must be multiplied, think $60 \div 20 = 3$; multiply both terms by 3.
 $\frac{4}{15} = \frac{16}{60}$
 $\frac{7}{12} = \frac{35}{60}$
 $\frac{21}{60} + \frac{16}{60} + \frac{35}{60} = \frac{72}{60} = \frac{6}{5} = 1\frac{1}{5}$ How may you find by what number both terms of $\frac{4}{15}$ must be multiplied? of $\frac{7}{12}$?

ACCURACY AND SPEED TESTS IN ADDITION

. Practice until you can find the correct sums in these 12 examples in addition in 3 minutes:

<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>
$\frac{7}{8}$	$\frac{5}{16}$	$\frac{3}{10}$	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{2}{5}$	$\frac{4}{5}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{7}{13}$	$\frac{5}{6}$
$\frac{5}{8}$	$\frac{1}{4}$	$\frac{4}{5}$	$\frac{5}{12}$	$\frac{7}{12}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{5}{8}$	$\frac{7}{8}$	$\frac{3}{10}$	$\frac{7}{10}$

. In how much less than 10 minutes can you find the sums in following 16 examples?

<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
$3\frac{1}{3}$	$2\frac{3}{8}$	$2\frac{4}{9}$	$3\frac{5}{8}$	$2\frac{2}{3}$	$3\frac{5}{8}$	$2\frac{3}{10}$
$2\frac{2}{3}$	$1\frac{1}{8}$	$3\frac{7}{9}$	$2\frac{5}{8}$	$4\frac{2}{9}$	$2\frac{3}{4}$	$1\frac{1}{5}$
$2\frac{1}{3}$	$2\frac{1}{4}$	$4\frac{4}{5}$	$2\frac{2}{9}$	$4\frac{3}{8}$	$1\frac{1}{10}$	$2\frac{5}{6}$
$3\frac{1}{2}$	$3\frac{3}{5}$	$3\frac{5}{6}$	$1\frac{1}{6}$	$5\frac{7}{10}$	$1\frac{1}{15}$	$1\frac{3}{10}$

ACCURACY AND SPEED TESTS IN ADDITION AND SUBTRACTION

1. Time yourself to see how long it takes you to find the correct answers to the following 16 examples in addition:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	
$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{4}$	$1\frac{1}{2}$	$\frac{1}{4}$	$\frac{2}{3}$	$2\frac{1}{3}$	7
$\frac{3}{8}$	$\frac{3}{8}$	$\frac{3}{4}$	$2\frac{1}{2}$	$\frac{3}{8}$	$\frac{5}{6}$	$3\frac{3}{4}$	3
$\frac{3}{8}$	$\frac{5}{8}$	$\frac{3}{4}$	$3\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$	$5\frac{1}{8}$	1
$2\frac{2}{5}$	$7\frac{1}{8}$	$\frac{7}{10}$	$3\frac{1}{3}$	$2\frac{5}{6}$	$\frac{7}{12}$	$\frac{7}{20}$	2
$3\frac{1}{10}$	$3\frac{5}{12}$	$\frac{3}{5}$	$6\frac{2}{3}$	$3\frac{1}{2}$	$\frac{3}{8}$	$\frac{5}{12}$	3
$2\frac{1}{2}$	$2\frac{5}{6}$	$\frac{5}{6}$	$1\frac{1}{6}$	$4\frac{2}{3}$	$\frac{5}{16}$	$\frac{7}{30}$	1

2. Find the differences in the following 10 examples in subtraction in less than 3 minutes. Check results.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
$\frac{3}{5}$	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{7}{12}$	$\frac{9}{10}$	$\frac{1}{2}$	$\frac{9}{10}$	$\frac{4}{5}$	$\frac{3}{4}$
$\frac{2}{5}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{2}$	$\frac{3}{10}$	$\frac{2}{5}$	$\frac{3}{4}$	$\frac{1}{16}$

3. Time yourself in finding the differences in the following examples in subtraction. Check results.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
$8\frac{2}{3}$	$4\frac{5}{8}$	$8\frac{7}{12}$	$9\frac{2}{3}$	$8\frac{7}{8}$	$7\frac{5}{8}$	$9\frac{5}{8}$
3	$\frac{1}{8}$	$\frac{1}{3}$	$\frac{1}{4}$	$1\frac{1}{8}$	$2\frac{2}{3}$	$2\frac{1}{6}$
10	$4\frac{1}{4}$	$5\frac{1}{2}$	$8\frac{1}{6}$	$9\frac{2}{3}$	$8\frac{1}{8}$	$7\frac{1}{3}$
$6\frac{2}{3}$	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{3}{4}$	$2\frac{7}{8}$	$3\frac{5}{6}$
4	$5\frac{3}{4}$	$8\frac{1}{8}$	$7\frac{5}{16}$	$9\frac{2}{3}$	$7\frac{1}{9}$	$8\frac{1}{12}$
$3\frac{7}{8}$	$4\frac{3}{8}$	$3\frac{3}{4}$	$2\frac{1}{4}$	$1\frac{5}{6}$	$3\frac{2}{3}$	$1\frac{5}{6}$

MULTIPLICATION

1. Review pages 65-74.

Find the products, naming as many as possible at sight :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
2.	$2 \times \frac{1}{2}$	$2 \times \frac{1}{8}$	$3 \times \frac{2}{3}$	$3 \times \frac{2}{9}$	$4 \times \frac{7}{12}$
3.	$4 \times \frac{2}{9}$	$4 \times \frac{3}{16}$	$\frac{5}{12} \times 6$	$2\frac{1}{2} \times 8$	$2\frac{1}{2} \times 5$
4.	$\frac{1}{2} \times \frac{3}{5}$	$\frac{3}{4} \times \frac{8}{9}$	$\frac{7}{9} \times \frac{15}{16}$	$\frac{5}{8} \times \frac{8}{15}$	$\frac{15}{16} \times \frac{24}{25}$
5.	$2\frac{1}{2} \times \frac{3}{4}$	$3\frac{1}{3} \times \frac{3}{4}$	$5 \times 2\frac{1}{10}$	$5 \times 2\frac{1}{5}$	$6 \times 3\frac{1}{3}$
6.	$8 \times 2\frac{1}{2}$	$3 \times 3\frac{5}{8}$	$\frac{2}{3} \times 5\frac{2}{5}$	$\frac{1}{4} \times 4\frac{4}{9}$	$\frac{1}{3} \times 3\frac{1}{3}$
7.	$\frac{5}{12} \times 3\frac{1}{5}$	$2\frac{1}{3} \times 4\frac{1}{2}$	$1\frac{3}{5} \times 6\frac{1}{4}$	$2\frac{3}{4} \times 3\frac{1}{2}$	$4\frac{4}{9} \times 3\frac{3}{8}$
8.	$1\frac{1}{2} \times 1\frac{1}{2}$	$2\frac{1}{2} \times 2\frac{1}{2}$	$3\frac{1}{3} \times 2\frac{2}{3}$	$7\frac{1}{2} \times 3\frac{3}{4}$	$1\frac{1}{9} \times 7\frac{1}{2}$
9.	$1\frac{2}{3} \times 3\frac{3}{4}$	$\frac{1}{2} \times 12\frac{1}{2}$	$4\frac{1}{8} \times 2\frac{2}{3}$	$10\frac{2}{3} \times \frac{5}{16}$	$\frac{4}{9} \times 2\frac{1}{4}$
10.	$3\frac{1}{3} \times \frac{3}{10}$	$14\frac{2}{7} \times \frac{1}{10}$	$6\frac{2}{3} \times \frac{3}{10}$	$\frac{2}{15} \times 7\frac{1}{2}$	$6\frac{1}{4} \times \frac{2}{25}$
11.	$66\frac{2}{3}$ <u>9</u>	36 <u>$8\frac{3}{4}$</u>	42 <u>$7\frac{1}{8}$</u>	$36\frac{7}{8}$ <u>8</u>	$48\frac{3}{4}$ <u>9</u>
12.	$38\frac{1}{8}$ <u>8</u>	$56\frac{3}{10}$ <u>7</u>	84 <u>$3\frac{7}{12}$</u>	75 <u>$8\frac{1}{8}$</u>	63 <u>$9\frac{3}{4}$</u>
13.	$25\frac{1}{4}$ <u>$16\frac{1}{5}$</u>	$36\frac{4}{5}$ <u>$25\frac{3}{4}$</u>	$33\frac{1}{3}$ <u>$12\frac{1}{3}$</u>	$48\frac{3}{4}$ <u>$24\frac{1}{2}$</u>	$56\frac{1}{9}$ <u>$63\frac{5}{8}$</u>
14.	$66\frac{2}{3}$ <u>$33\frac{1}{3}$</u>	$87\frac{3}{8}$ <u>$32\frac{1}{2}$</u>	$42\frac{6}{7}$ <u>$44\frac{2}{3}$</u>	$87\frac{1}{2}$ <u>$12\frac{1}{2}$</u>	$42\frac{6}{7}$ <u>$60\frac{7}{8}$</u>
15.	$66\frac{2}{3}$ <u>$30\frac{5}{6}$</u>	$84\frac{3}{10}$ <u>$40\frac{7}{12}$</u>	$75\frac{5}{6}$ <u>$24\frac{3}{5}$</u>	$63\frac{5}{8}$ <u>$54\frac{1}{2}$</u>	$72\frac{7}{8}$ <u>$45\frac{1}{5}$</u>
16.	$50\frac{4}{5}$ <u>$40\frac{4}{5}$</u>	$12\frac{1}{2}$ <u>$12\frac{1}{2}$</u>	$16\frac{2}{3}$ <u>$16\frac{2}{3}$</u>	$60\frac{6}{7}$ <u>$70\frac{5}{6}$</u>	$33\frac{1}{3}$ <u>$24\frac{2}{9}$</u>
17.	$\frac{2}{3} \times \frac{9}{10} \times \frac{5}{6}$	18. $\frac{5}{12} \times \frac{8}{9} \times \frac{6}{25}$	19. $\frac{9}{10} \times \frac{3}{12} \times \frac{24}{25}$	20. $\frac{5}{16} \times \frac{8}{15} \times \frac{6}{7}$	
18.	$\frac{5}{8} \times \frac{16}{3} \times \frac{9}{10}$	22. $\frac{7}{12} \times \frac{16}{21} \times \frac{9}{8}$	23. $\frac{15}{16} \times \frac{24}{25} \times \frac{10}{9}$	24. $1\frac{1}{4} \times 2\frac{2}{3} \times 1\frac{4}{5}$	

REVIEW AND PRACTICE IN DIVISION

1. How may we divide a fraction by a whole number?

(Review page 75.)

2. Name the quotients: $\frac{2}{3} \div 2$; $\frac{4}{9} \div 2$; $\frac{1}{2} \div 2$; $\frac{1}{4} \div 2$; $\frac{2}{3} \div 3$; $\frac{3}{4} \div 5$; $\frac{1}{2} \div 5$; $2\frac{2}{3} \div 2$; $2\frac{1}{2} \div 2$; $6\frac{2}{3} \div 3$.

3. Name the inverse of: $\frac{1}{2}$; $\frac{3}{4}$; $\frac{10}{9}$; $1\frac{1}{4}$; $\frac{7}{8}$; $\frac{1}{8}$; $2\frac{1}{2}$; $\frac{1}{10}$.

4. Name the quotients (review pages 76 and 79):

$1 \div \frac{1}{2}$; $1 \div \frac{1}{5}$; $2 \div \frac{1}{2}$; $2 \div \frac{1}{3}$; $2 \div \frac{1}{10}$; $1 \div \frac{3}{5}$; $1 \div \frac{4}{3}$; $1 \div \frac{3}{2}$; $2 \div \frac{2}{3}$; $4 \div \frac{4}{9}$; $2 \div \frac{4}{5}$; $2 \div \frac{3}{8}$; $3 \div \frac{2}{3}$; $3 \div 1\frac{1}{2}$; $5 \div 2\frac{1}{2}$; $7 \div 3\frac{1}{2}$; $1\frac{1}{4} \div 5$; $6 \div 1\frac{1}{2}$

Divide as indicated:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
5.	$\frac{1}{2} \div \frac{1}{8}$	$\frac{3}{8} \div \frac{1}{4}$	$\frac{1}{3} \div \frac{1}{9}$	$\frac{1}{4} \div \frac{1}{8}$	$\frac{2}{3} \div \frac{1}{6}$
6.	$\frac{2}{3} \div \frac{4}{5}$	$\frac{7}{8} \div \frac{3}{8}$	$\frac{3}{16} \div \frac{7}{8}$	$\frac{4}{9} \div \frac{5}{12}$	$\frac{12}{25} \div \frac{5}{6}$
7.	$\frac{5}{8} \div \frac{5}{12}$	$\frac{7}{16} \div \frac{21}{32}$	$\frac{18}{25} \div \frac{8}{15}$	$\frac{9}{50} \div \frac{3}{10}$	$\frac{7}{15} \div \frac{10}{21}$
8.	$\frac{9}{32} \div \frac{27}{16}$	$\frac{15}{16} \div \frac{5}{12}$	$\frac{30}{50} \div \frac{9}{25}$	$\frac{27}{25} \div \frac{9}{50}$	$\frac{15}{16} \div \frac{9}{32}$
9.	$1\frac{1}{4} \div \frac{1}{4}$	$2\frac{1}{2} \div \frac{1}{2}$	$7\frac{1}{2} \div 2\frac{1}{2}$	$1\frac{1}{8} \div 3\frac{3}{8}$	$10 \div 1\frac{1}{4}$
10.	$20 \div 6\frac{2}{3}$	$\frac{1}{4} \div 2\frac{1}{4}$	$\frac{5}{8} \div 1\frac{2}{3}$	$\frac{3}{5} \div 1\frac{4}{5}$	$3\frac{1}{3} \div 2\frac{1}{2}$
11.	$2\frac{1}{4} \div 4\frac{1}{2}$	$8\frac{1}{3} \div 2\frac{1}{12}$	$6\frac{1}{4} \div 1\frac{9}{16}$	$12\frac{1}{2} \div 37\frac{1}{2}$	$62\frac{1}{2} \div 37$

DIVIDING BY A LARGE MIXED NUMBER

1. When the divisor is a large mixed number, the following is a desirable way of finding the quotient:

a. Divide 75 by $16\frac{2}{3}$.

$$\begin{array}{r} 16\frac{2}{3} \overline{) 75} \\ \underline{3 \quad 3} \\ 50 \\ \underline{225} (4\frac{1}{2} \\ 200 \\ \underline{25} \end{array}$$

In *a* both dividend and divisor are multiplied by the denominator of the fraction.

b. Divide $66\frac{2}{3}$ by $12\frac{1}{2}$.

$$\begin{array}{r} 12\frac{1}{2} \overline{) 66\frac{2}{3}} \\ \underline{6 \quad 6} \\ 75 \\ \underline{400} (5\frac{1}{2} \\ 375 \\ \underline{25} \end{array}$$

In *b* both dividend and divisor are multiplied by 6, the L. C. of the fractions.

Divide as indicated :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
2.	$100 \div 37\frac{1}{2}$	$100 \div 87\frac{1}{2}$	$100 \div 33\frac{1}{3}$	$100 \div 66\frac{2}{3}$	$100 \div 62\frac{1}{2}$
3.	$133\frac{1}{3} \div 66\frac{2}{3}$	$87\frac{1}{2} \div 62\frac{1}{2}$	$237\frac{1}{2} \div 33\frac{1}{3}$	$144\frac{4}{9} \div 16\frac{2}{3}$	$183\frac{1}{3} \div 26\frac{2}{3}$
4.	$166\frac{2}{3} \div 66\frac{2}{3}$	$375 \div 37\frac{1}{2}$	$444\frac{4}{9} \div 55\frac{5}{9}$	$166\frac{2}{3} \div 88\frac{8}{9}$	$555\frac{5}{9} \div 33\frac{1}{3}$

COMPARISON

- Count this way : 1 is $\frac{1}{5}$ of 5, 2 is $\frac{2}{5}$ of 5, and so on to 9 is $\frac{9}{5}$ of 5.
- Complete : $1 \div 5 = \frac{1}{5}$, $2 \div 5 = \frac{2}{5}$, and so on to $9 \div 5 = \frac{9}{5}$.
- Complete : $1 \div 4 = \frac{1}{4}$, $2 \div 4 = \frac{2}{4}$, or $\frac{1}{2}$, and so on to $9 \div 4 = 2\frac{1}{4}$.
- Name the quotients at sight :

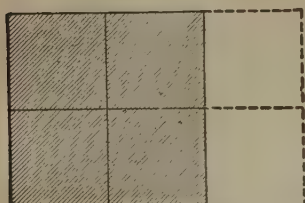
$\div 4$	$3 \div 7$	$4 \div 9$	$6 \div 8$	$8 \div 6$	$4 \div 8$
$\div 10$	$9 \div 6$	$6 \div 9$	$5 \div 6$	$8 \div 10$	$15 \div 20$
$\div 2$	$2 \div 3$	$7 \div 8$	$7 \div 10$	$9 \div 8$	$20 \div 25$
- To find what part of 5 is 3, we may divide 3 by 5. $3 \div 5 = ?$
What part of 5 is 3?
- How may we find what part of 5 is 4? of 5 is 2? of 7 is 2?
- What part of 5 is 4? of 5 is 2? of 7 is 2?
- What part of 4 is 3? What part of 3 is 4?
- Tell what part of \$10 is each of the following :

\$2	\$4	\$7	\$9	\$8	\$6	\$2\frac{1}{2}
-----	-----	-----	-----	-----	-----	----------------
- Tell what part of 6 yd. is each of the following :

yd.	5 yd.	2 yd.	4 yd.	9 yd.	3 yd.	$1\frac{1}{2}$ yd.	$4\frac{1}{2}$ yd.
-----	-------	-------	-------	-------	-------	--------------------	--------------------
- If Edward sells radishes at the rate of 10¢ for 3 bunches, how many times 10¢ should he receive for 6 bunches? 9 bunches? 12 bunches? How much should he receive for 6 bunches? 9 bunches? 12 bunches? 15 bunches?

FINDING THE WHOLE WHEN A PART IS GIVEN

1. What part of this rectangle is shaded?



2. How many squares are there in the shaded part?

3. Are these statements true?

$\frac{2}{3}$ of the rectangle contains squares.

$\frac{1}{3}$ of the rectangle contains $\frac{1}{2}$ of squares, or 2 squares.

$\frac{3}{8}$ of the rectangle contains 3×2 squares, or 6 squares.

4. If $\frac{1}{2}$ of a number is 3, what is the number?

5. If $\frac{3}{4}$ of a number is 6, what is $\frac{1}{4}$ of the number? $\frac{4}{4}$ of the number?

6. Find the number of which 8 is $\frac{4}{5}$; 9 is $\frac{3}{5}$; 10 is $\frac{5}{8}$.

7. Beatrice paid 30¢ for $\frac{3}{4}$ yd. of ribbon. What was the price per yard?

8. In one day Hugh sold 20 copies of a magazine; these were $\frac{2}{5}$ of all he bought. How many did he buy?

9. Allan and Clarence bought a sled. Allan paid \$3.60 which was $\frac{3}{5}$ of the cost of the sled. What was the cost? What part of the cost did Clarence pay? How much did he pay?

10. Gertrude has \$3.75 saved for Christmas. This is $\frac{5}{8}$ what she needs to buy gifts. How much does she need?

11. Betty sold 40 tickets for an entertainment, which number was $\frac{4}{5}$ of the number that Nora sold. How many did they both sell?

12. If it requires a carpenter 3 hr. to repair a door at Mr. White's home, what part of a day does it require, counting 24 hours as a working day? If the carpenter is paid \$3 for the work, what is he charging per day?

Complex Fractions. Such expressions as $\frac{\frac{2}{3}}{4}$, $\frac{12\frac{1}{2}}{100}$, $\frac{3}{\frac{4}{3}}$, $\frac{9}{2\frac{1}{4}}$, and $\frac{\frac{3}{8}}{\frac{3}{4}}$ are called *complex fractions*. The first, $\frac{\frac{2}{3}}{4}$, means that $\frac{2}{3}$ is to be divided by 4. It is reduced to simplest form thus:

$$\frac{\frac{2}{3}}{4} = \frac{2}{3} \div 4 = \frac{2}{3} \times \frac{1}{4} = \frac{1}{6}.$$

SIMPLIFYING COMPLEX FRACTIONS

Reduce to simplest form:

1. $\frac{12\frac{1}{2}}{100} = 12\frac{1}{2} \div 100 =$

2. $\frac{3}{\frac{4}{3}} = 3 \div \frac{4}{3} =$

3. $\frac{9}{2\frac{1}{4}} = 9 \div 2\frac{1}{4} =$

4. $\frac{\frac{3}{8}}{\frac{3}{4}} = \frac{3}{8} \div \frac{3}{4} =$

Any example in division involving a fraction or a mixed number can be expressed as a complex fraction; thus, $\frac{3}{4} \div \frac{2}{3} = \frac{\frac{3}{4}}{\frac{2}{3}}$. Express

each of the parts of examples 5 and 6, page 164, as a complex fraction and reduce it to simplest form.

There is nothing new involved in the complex fractions of this book. They mean only, in each case, that one number is to be divided by another. The work of reducing each to simplest form is only a review of division involving a fraction or a mixed number.

- | | | | | |
|---------------------------------|--|---------------------------------|---------------------------------|---------------------------------|
| 5. $\frac{\frac{4}{5}}{2}$ | 6. $\frac{\frac{3}{4}}{2}$ | 7. $\frac{5}{\frac{2}{3}}$ | 8. $\frac{2\frac{1}{2}}{4}$ | 9. $\frac{10}{2\frac{1}{2}}$ |
| 10. $\frac{7\frac{1}{2}}{10}$ | 11. $\frac{2\frac{1}{2}}{12\frac{1}{2}}$ | 12. $\frac{37\frac{1}{2}}{100}$ | 13. $\frac{6\frac{1}{4}}{100}$ | 14. $\frac{6\frac{1}{4}}{25}$ |
| 15. $\frac{42\frac{6}{7}}{100}$ | 16. $\frac{6\frac{2}{3}}{100}$ | 17. $\frac{33\frac{1}{3}}{100}$ | 18. $\frac{62\frac{1}{2}}{100}$ | 19. $\frac{87\frac{1}{2}}{100}$ |
| 20. $\frac{11\frac{1}{9}}{100}$ | 21. $\frac{8\frac{1}{3}}{100}$ | 22. $\frac{16\frac{2}{3}}{100}$ | 23. $\frac{14\frac{2}{7}}{100}$ | 24. $\frac{66\frac{2}{3}}{100}$ |

PROBLEMS INVOLVING FRACTIONS

1. If a remnant of ribbon containing $1\frac{1}{4}$ yd. was bought for 25¢, how much was that a yard?
2. When Eleanor's cyclometer registered $2\frac{1}{4}$ miles, she found that she had ridden 6 times around the race track. What was the length of the race track?
3. A drawing was made to represent a garden of 5 sides, and the scale used was $1'' = 20'$. State how long the sides of the garden are if they measure on the drawing $3\frac{1}{2}''$, $1\frac{3}{4}''$, $2\frac{1}{8}''$, $3\frac{1}{4}''$, and $2\frac{7}{8}''$.
4. How may you check your answer in an example in subtraction of fractions? Illustrate.
5. If an automobile makes 18 mi. on a gallon of gasoline which costs 34¢, what is the cost per mile for gasoline?
6. Which is the greater fraction and how much: $\frac{3}{8}$ or $\frac{5}{8}$?
7. If two fractions have equal denominators and unequal numerators, which is the greater fraction, the one having the greater numerator or the one having the less?
8. Which is the greater and how much: $\frac{5}{8}$ or $\frac{5}{9}$?
9. If two fractions have equal numerators and unequal denominators, which is the greater fraction?
10. When a $\frac{5}{8}$ -bushel basket of apples sells for \$0.75, what is the price per bushel?
11. Illustrate two ways of multiplying a mixed number by a mixed number.
12. Oliver raised 40 bu. of potatoes on a lot containing $\frac{5}{8}$ of an acre. This was a yield of how many bushels per acre?
13. Illustrate two ways of dividing a mixed number by a mixed number.
14. What is the cost of $1\frac{3}{4}$ T. of coal at \$19 a ton?

15. A 2-lb. box of lump sugar contains how many lumps of oz. each?
16. Lawrence picked 19 half-bushel baskets of apples and was paid 10¢ a bushel for picking them. How much did he earn?
17. A piece of cloth $1\frac{3}{4}$ yd. long shrank $\frac{1}{8}$ yd. in sponging. How long was it then?
18. May's father bought $\frac{1}{2}$ T. of hay for her pony. What did the hay cost him at \$28.50 a ton?
19. If green coffee loses $\frac{1}{10}$ of its weight in roasting, 5 lb. of green coffee should make how many pounds of roasted coffee?
20. If two fractions have a common denominator, how are they added? How are they subtracted?
21. One peck is $\frac{1}{4}$ of a bushel and a quart is $\frac{1}{8}$ of a peck. What part of a bushel is a quart?
22. What length of line is required to represent a line 2 ft. long, drawn to a scale of $\frac{1}{4}$ " to a foot?
23. If two or more fractions do not have the same denominator, what must be done before they can be added?
24. What length of line is required to represent a line 48 ft. long, drawn to a scale of $\frac{1}{8}$ " to a foot?
25. What was the yield from each bushel of seed sown if the field was 30 bu. from $2\frac{1}{2}$ bu. of seed?
26. If two fractions do not have the same denominator, what must be done before they can be subtracted?
27. Mrs. Adams bought $1\frac{1}{2}$ doz. eggs at 60¢ a dozen; $\frac{3}{4}$ lb. of tied beef at 60¢ a pound; $\frac{3}{4}$ lb. of lard at 28¢ a pound. What was her bill?
28. How many ounces of cheese should William receive for 20¢ when cheese is selling at 32¢ a pound?

29. Draw to a scale of $\frac{1}{2}$ " to a foot a rectangle 6 ft. long and 2 ft. wide.

30. How can you test whether or not a fraction is in lowest terms?

31. Add 2 to both terms of the fraction $\frac{3}{4}$ and tell whether or not this changes its value. Test.

32. Does subtracting 2 from both terms of $\frac{3}{4}$ change its value? Test.

33. Does multiplying both terms of $\frac{3}{4}$ by 2 change its value? Prove your answer.

34. Does dividing both terms of $\frac{3}{4}$ by 2 change its value? Prove your answer.

35. When milk is selling at 15¢ a quart, what price is that per 100 lb., taking the weight of a quart of milk to be $2\frac{1}{2}$ lb.?

36. Simplify this expression by cancellation: $\frac{\frac{1}{2} \times 5 \times \frac{3}{4} \times 5\frac{1}{3}}{\frac{1}{4} \times 2\frac{1}{2} \times \frac{3}{5} \times 8}$.

37. What average does a girl receive in four studies if she receives a mark of 96 in one, 95 in another, 93 in another, and 99 in another?

38. When a merchant sold a 15¢ tablet for 12¢, what reduction in price was he making? The reduction was what part of 15¢? Express the part in lowest terms and then reduce the fraction to one whose denominator is 100.

39. When oranges are selling at 60¢ a dozen, what should be paid for 6 oranges? 3 oranges? 4 oranges? 2 oranges? 9 oranges?

40. What part of a dollar is (use complex fractions):

$12\frac{1}{4}$ ¢? $37\frac{1}{2}$ ¢? $62\frac{1}{2}$ ¢? $87\frac{1}{2}$ ¢? $33\frac{1}{3}$ ¢? $66\frac{2}{3}$ ¢? $16\frac{2}{3}$ ¢?

41. If Clara's teacher saves $\frac{1}{4}$ of her salary, how much salary does she receive per month if she saves \$30 each month? She spends $\frac{3}{8}$ of her salary for board. How much does she pay for board per month?
42. Richard lives in the country $2\frac{1}{4}$ miles from the town high school which he attends. He walks to and from school each day. How far does he walk in going to and from school in a month of 20 days?
43. Solve by cancellation: $\frac{12\frac{1}{2} \times 37\frac{1}{2} \times 18\frac{3}{4}}{62\frac{1}{2} \times 6\frac{1}{4} \times 25}$.
44. Frank and Edward sifted ashes for Mr. Hart. Frank worked $2\frac{1}{2}$ hours and Edward worked $1\frac{1}{4}$ hours more than Frank. How many hours did both work? Mr. Hart paid them 30¢ an hour each. How much did they both earn?
45. If 6 lb. of seed are put up in packages of $\frac{1}{2}$ lb. and $\frac{1}{4}$ lb., the same number of each, how many are there of each?
46. Mr. Barr lost $2\frac{1}{2}$ ¢ a pound by selling 10 lb. of sugar for 1¢. What did the 10 lb. cost him?
47. How many plats each containing $\frac{1}{16}$ of an acre can be made from a garden containing $\frac{3}{8}$ of an acre?
48. If 9 pieces each $6\frac{1}{4}$ in. long are cut from an iron rod 12 ft. long, what is the length of the piece that remains?
49. If 2 pieces each $2\frac{1}{4}$ ft. long are sawed from each end of a board 12 ft. long, what is the length of the piece that remains?
50. Estimating $1\frac{3}{4}$ bu. of wheat as quantity required to seed 1 acre, how many bushels are required to seed $10\frac{1}{2}$ acres?
51. If $1\frac{1}{2}$ times a number is 36, what is $\frac{1}{2}$ of the number? Give your answer.

CHAPTER III

DECIMALS

Decimals. $\frac{5}{10}$ may be written .5; $\frac{3}{100}$ may be written .03; $\frac{7}{1000}$ may be written .007. Numbers like .5, .03, and .007 are called *decimals*.

Common Fractions. Fractions like $\frac{1}{2}$, $\frac{2}{3}$, $\frac{7}{10}$, and $\frac{9}{100}$, which have their denominators expressed, are called *common fractions*.

Decimal Places. The places to the right of the decimal point are called *decimal places*.

READING AND WRITING TENTHS, HUNDREDTHS, THOUSANDTHS

1. What is the first place to the right of the decimal point called? the second place? the third place?

2. Read: A dime is .1 of a dollar; a cent is .01 of a dollar; a mill is .001 of a dollar.

3. Read: A rod is 5.5 yards, or 16.5 feet (use the word *and* for the decimal point).

4. Read this news item: "The total output of the average farmer is probably greater in the United States than in any other country in the world. Thus, in Belgium, with its intensive system of farming, only about 5.3 acres are cultivated for each person engaged in agriculture, whereas, in the United States, the corresponding figure is 27 acres. Taking both acreage and yield per acre into consideration, the average American farmer produces 2.5 times as much as the average Belgian farmer; 2.3 times

ch as the English; 3.2 times as much as the French; 2.5
es as much as the German, and over 6 times as much as the
lian."

. Read these decimals: .7; .08; .006; .9; .03; .002; .6;
; .009; .07; .007; .04; .003; .004; .05; .005.

Write each of these fractions without a denominator:

$$\frac{2}{10} \quad \frac{8}{10} \quad \frac{7}{10} \quad \frac{6}{100} \quad \frac{9}{100} \quad \frac{5}{10} \quad \frac{8}{1000} \quad \frac{9}{1000} \quad \frac{6}{1000}$$

. Write the decimals of example 5 in words.

. Write and read ten common fractions; ten decimals.

Table. Study the table. Begin at the decimal point and name
decimal places. Then name them without looking at your book.

Hundreds	Tens	Units	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths
7	2	6	.	0	3	8	0	4
								5

The number in the table is read *seven hundred twenty-six and
ty-eight thousand forty-five millionths*; or, *seven-two-six-point-o-
e-eight-o-four-five*, o being used instead of zero.

READING AND WRITING DECIMALS

Read .35. Thus, *35 hundredths*.

Read .426. Thus, *426 thousandths*.

Read .4275. Thus, *4275 ten-thousandths*.

Read .57867. Thus, *57867 hundred-thousandths*.

Read .000756. Thus, *756 millionths*.

Notice that a decimal is usually read by reading the number expressed by the figures of the decimal, disregarding the decimal point, and then naming the order or place in which the right-hand figure stands.

6. Read these decimals, then write them from dictation :

.75	.205	.047	.4568	.9008	.7645
.096	.7583	.9326	.8547	.0625	.4046
.7632	.9463	.3048	.3706	.45359	.9081

7. Read 3.1416. Thus, *3 and 1416 ten-thousandths*.

Notice that in reading a number consisting of a whole number and a decimal, *and* is read at the decimal point.

Read the following :

8. A knot, used to measure distances at sea, is 1.152 miles.

9. A bushel contains 2150.42 cubic inches.

10. A meter, the unit of length in some countries, equals 39.37 inches.

11. A kilogram = 2.2046 pounds; a kilometer = 0.62137 miles.

12. Read **these numbers**, then write them from dictation :

48.2756	10.0006	25.00065	18.000765	80.475
85.4006	28.0204	50.70045	25.736285	40.700

Write the following numbers in figures :

13. Eight tenths; seventy-five hundredths; seven hundred and two hundredths; thirty hundredths.

14. Two hundred seventy-five thousandths; eighteen thousandths; eight thousandths; eighty thousandths; two hundred seventy thousandths; two hundred seven thousandths.

15. Fourteen ten-thousandths; fifty-six hundred-thousandths; two hundred twenty-five millionths; six millionths.

READING DECIMALS TO A DESIRED DEGREE OF ACCURACY

Sometimes, instead of one number, a more convenient number, which is nearly equal to it, is used.

If the price of 3 oranges is 20¢, the price of 1 orange of the 3 is nearly 7¢, which probably would be the cost of 1 orange if 1 alone of the 3 were bought. Again, a cubic foot of water contains about 7.48 gallons, but 7.5 gallons is sometimes used instead, that is, in cases where its use would make but slight difference in the answer.

1. In \$37.86, tell for what amount of money each figure stands.
2. Is 6¢ more or less than half a dime?
3. \$0.86 is nearer which amount: \$0.90 or \$0.80?
4. Read \$37.86 correct to the nearest dime.
5. \$37.86 is nearer which amount: \$38 or \$37?
6. Read \$37.86 correct to the nearest dollar.
7. Is 8 mills more or less than half a cent?
8. Read \$0.528 correct to the nearest cent.
9. Read \$0.983 correct to the nearest cent.
10. \$0.528 is nearer which amount: \$0.60 or \$0.50?
11. Read \$0.528 correct to the nearest dime.
12. Read 4.827 correct to the nearest hundredth; to the nearest tenth; to the nearest unit.
13. Read 3.1416 correct to the nearest thousandth; to the nearest hundredth; to the nearest tenth; to the nearest unit.
14. A bill of goods amounted to \$7.386. What was the bill correct to the nearest cent?

In making settlement, bills are usually paid correct to the nearest cent, and half cent being considered a cent.

READING AND WRITING DECIMALS

The decimal $.33\frac{1}{3}$ is read *thirty-three and one third hundredths* and $2.12\frac{1}{2}$ is read *two and twelve and one half hundredths*.

1. Read these numbers:

$.06\frac{1}{4}$	$.12\frac{1}{2}$	$.37\frac{1}{2}$	$.62\frac{1}{2}$	$.87\frac{1}{2}$	$.08\frac{1}{3}$	.1
$.66\frac{2}{3}$	$.14\frac{2}{7}$	$.28\frac{4}{7}$	$.11\frac{1}{9}$	$.22\frac{2}{9}$	$.07\frac{1}{2}$	.4

Write without a denominator:

2. $\frac{25}{100}$ Thus, .25.
3. $\frac{25}{1000}$ Thus, .025.
4. $\frac{25}{10000}$ Thus, .0025.
5. $\frac{33\frac{1}{3}}{100}$ Thus, $.33\frac{1}{3}$.

Notice that the decimal form is the numerator of the fraction so written that the last figure of the numerator is in hundredths place when the denominator of the fraction is 100; in thousandths place when the denominator is 1000, and so on, the ciphers being used when necessary.

Write each of the following without a denominator:

6. $\frac{1}{100}$ $\frac{2}{100}$ $\frac{6}{1000}$ $\frac{7}{10000}$ $\frac{8}{100000}$ $\frac{9}{1000000}$
7. $\frac{48}{100}$ $\frac{65}{100}$ $\frac{75}{1000}$ $\frac{87}{10000}$ $\frac{95}{100000}$ $\frac{82}{1000000}$
8. $\frac{275}{1000}$ $\frac{856}{1000}$ $\frac{285}{10000}$ $\frac{4875}{100000}$ $\frac{8325}{1000000}$ $\frac{9756}{10000000}$
9. $2\frac{75}{100}$ $5\frac{32}{1000}$ $9\frac{575}{1000}$ $8\frac{27}{1000}$ $10\frac{275}{10000}$ $25\frac{345}{100000}$
10. $\frac{12\frac{1}{2}}{100}$ $\frac{37\frac{1}{2}}{100}$ $\frac{66\frac{2}{3}}{100}$ $\frac{8\frac{1}{3}}{100}$ $\frac{16\frac{2}{3}}{100}$ $\frac{62\frac{1}{2}}{100}$

Write in decimal form:

11. $16\frac{2}{3}$ hundredths; $12\frac{1}{2}$ hundredths; $33\frac{1}{3}$ thousandths.
12. $66\frac{2}{3}$ thousandths; $33\frac{1}{3}$ hundredths; 45 ten-thousandths.

13. Four hundred sixteen thousandths; seven ten-thousandths.
 14. Four hundred and sixteen thousandths is written *400.016*.
 What separates the integer from the decimal?
 15. Six thousand and six thousandths.

REDUCTION OF DECIMALS

1. Is this statement true: $\frac{7}{10} = \frac{70}{100} = \frac{700}{1000} = \frac{7000}{10000}$? Why?
 2. Is this statement true: $.7 = .70 = .700 = .7000$? Why?
 3. What truth does the statement in example 2 illustrate?
 (see page 93.)

4. Reduce to tenths:

0 .50 .80 .900 .700 .5000 .60000

5. Reduce to hundredths:

.1 .3 .9 .5 .500 .700 .8000

6. Reduce to thousandths:

.1 .8 .5 .25 .75 .90 .7560

Reduce to common fractions in lowest terms:

7. .625. Thus, $\frac{625}{1000}$, or $\frac{5}{8}$.

8. $.66\frac{2}{3}$. Thus, $\frac{66\frac{2}{3}}{100} = \frac{3 \times 66\frac{2}{3}}{3 \times 100} = \frac{200}{300} = \frac{2}{3}$.

9. .45	.75	.35	.65	.15
10. .125	.375	.875	.075	.225
11. $.12\frac{1}{2}$	$.14\frac{2}{7}$	$.18\frac{3}{4}$	$.37\frac{1}{2}$	$87\frac{1}{2}$
12. $.8\frac{1}{3}$	$.33\frac{1}{3}$	$.83\frac{1}{3}$	$.28\frac{4}{7}$	$.6\frac{1}{4}$
13. $.06\frac{1}{4}$	$.42\frac{6}{7}$	$.58\frac{1}{3}$	$.16\frac{2}{3}$	$.08\frac{1}{3}$
14. $.333\frac{1}{3}$	$.02\frac{1}{2}$	$.166\frac{2}{3}$	$.833\frac{1}{3}$	$.666\frac{2}{3}$

ADDITION AND SUBTRACTION

Emily wrote, as here shown, the money her mother paid in one year for five items of family expenses. What was the amount of each bill for the year?

	1. GAS	2. ELECTRIC LIGHT	3. TELEPHONE	4. MILK	5. GROCERIES
<i>Jan.</i>	\$2.80	\$3.48	\$2.30	\$13.95	\$18.68
<i>Feb.</i>	3.51	3.95	2.10	12.60	22.96
<i>Mar.</i>	3.38	3.48	2.60	13.95	21.42
<i>Apr.</i>	3.78	3.75	3.10	12.45	19.35
<i>May</i>	3.04	2.75	2.80	12.15	18.72
<i>June</i>	2.86	2.05	2.70	8.85	16.40
<i>July</i>	3.04	1.25	2.20	9.00	14.35
<i>Aug.</i>	3.78	1.00	2.00	8.70	12.10
<i>Sept.</i>	2.91	1.19	2.80	9.15	15.15
<i>Oct.</i>	5.43	2.80	2.60	10.35	18.62
<i>Nov.</i>	4.24	3.12	2.60	10.80	19.84
<i>Dec.</i>	<u>3.05</u>	<u>3.48</u>	<u>2.80</u>	<u>13.95</u>	<u>25.75</u>

Subtract and check:

6. \$7.28 <u>2.89</u>	7. 6.26 ft. <u>3.98 ft.</u>	8. 8.4 lb. <u>2.25 lb.</u>	9. 8.00 mi. <u>2.76 mi.</u>	10. 9.26 s <u>7.58 s</u>
11. 7.005 <u>3.204</u>	12. 3.705 <u>2.009</u>	13. 9.5 <u>2.589</u>	14. 8.1 <u>2.909</u>	15. 9.7 <u>2.075</u>

16. Charles wishes to buy a sled for \$4.75 and a pair of gloves for \$1.75. He has \$5.25. How much more does he need?

17. A war savings stamp costs \$4.12 in January, \$4.13 in February, \$4.14 in March, and so on. What does it cost if purchased in December?

Try to find the sums in these 4 examples in addition in 6 minutes:

3.	19.	20.	21.
26	.56832	.20086	.476854
67	.18796	.39765	.928326
04	.23586	.88769	.488700
21	.98965	.12357	.738429
95	.83265	.48396	.928561
26	.42577	.58787	.298976
48	.98765	.59683	.643785
54	.76858	.20685	.587669
78	<u>.39029</u>	<u>.43878</u>	<u>.843881</u>

Try to get the correct differences in these 4 examples in subtraction in 1 minute; then check:

22.	23.	24.	25.
217	.82001	.743000	.901020
342	<u>.28745</u>	<u>.256312</u>	<u>.237928</u>

PROBLEMS INVOLVING ADDITION AND SUBTRACTION OF DECIMALS

1. Mrs. Everett gives the following in making up the cost of a wash for her family for 1 week; find the cost: washerwoman, \$1.00; soap, 15¢; coal, 25¢; bluing, 5¢; meals, 50¢; wear and tear on tubs, brushes, etc., 50¢.

2. Mrs. Everett is thinking of buying an electric washer, but she first estimates the cost of a week's wash with the electric washer in use. Here is her estimate; find the total: wear, repairs, and depreciation, 75¢; soap, 15¢; coal, 25¢; bluing, 5¢; electricity, 15¢.

3. If Mrs. Everett uses an electric washer and does the work without the aid of a washerwoman, how much does she save each week?

4. The rainfall at New York for the first six months of a certain year was 2.44 in.; 1.70 in.; 3.38 in.; 2.35 in.; 3.29 in.; 5.57 in. What was the total rainfall for the six months?

1 inch of rainfall means 1 cubic inch of water falls on 1 square inch of surface.

5. The high-water mark of a certain river is 14.2 ft. above low-water mark. During a rainfall the river rose to within 4.8 ft. of high-water mark. How much above low-water mark was the river at that time?

6. The ice on a pond was 5.75 in. thick at 6 o'clock one morning and 7.5 in. thick the next morning at 6 o'clock. How much longer did it freeze in the 24 hr.?

7. The record for running high jump at Frank's school is 5.8 ft. Frank's record is 4.78 ft. How much is his record below the school record?

MULTIPLICATION INVOLVING DECIMALS

$$1. \ .3 \times .04 = \frac{3}{10} \times \frac{4}{100} = \frac{12}{1000} = .012.$$

Find the products in examples 2-5 as the product is found in example 1.

$$2. \ 3 \times .4$$

$$3. \ .3 \times .004$$

$$4. \ .03 \times .004$$

$$5. \ .003 \times .4$$

6. Look at the products in examples 1-5 and compare the number of decimal places in each product with the number of decimal places in the multiplicand and the multiplier together. In practice we arrange the work of examples 1-5 thus:

$$\begin{array}{r} .04 \\ .3 \\ \hline .012 \end{array}$$

$$\begin{array}{r} .4 \\ .3 \\ \hline 1.2 \end{array}$$

$$\begin{array}{r} .004 \\ .3 \\ \hline .0012 \end{array}$$

$$\begin{array}{r} .004 \\ .03 \\ \hline .00012 \end{array}$$

$$\begin{array}{r} .04 \\ .003 \\ \hline .00012 \end{array}$$

7. Write a rule for placing the decimal point in a product.

8. Compare the rule which you wrote with the rule given on page 100.

How many decimal places are there in the product in each of the following? Find the products.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
9.	9.8 <u>.03</u>	.35 <u>.03</u>	.42 <u>3</u>	.56 <u>.03</u>	.025 <u>.03</u>	750 <u>.03</u>
10.	54 <u>.06</u>	.54 <u>.04</u>	5.4 <u>.5</u>	54 <u>.008</u>	.54 <u>.004</u>	.054 <u>.07</u>
11.	\$2.75 <u>6.5</u>	\$3.80 <u>2.5</u>	\$5.90 <u>.35</u>	\$7.50 <u>.85</u>	\$0.75 <u>.75</u>	\$25.00 <u>.85</u>
12.	2.75 mi. <u>.25</u>	7.75¢ <u>9.5</u>	\$10.50 <u>.45</u>	1.65 A. <u>4.8</u>	3.2 lb. <u>.75</u>	14.6 in. <u>.025</u>
13.	.86 mi. <u>.75</u>	\$0.60 <u>1.9</u>	52.6 ft. <u>.075</u>	.87 ft. <u>.29</u>	3.1416 <u>9.5</u>	3.1416 <u>.08</u>

14. How many decimal places are there in the product if there are two decimal places in the multiplicand and two in the multiplier? three in the multiplicand and two in the multiplier? three in the multiplicand and three in the multiplier?

15. Steel weighs 7.81 times as much as water. Find the weight of a cubic foot of steel (1 cu. ft. of water weighs 62.5 lb.).

16. Iron weighs 7.788 times as much as water. Find the weight of a cubic foot of iron.

17. Cork weighs 0.24 times as much as water. Find the weight of a cubic foot of cork.

18. Mercury weighs 13.598 times as much as water. Find the weight of a cubic foot of mercury.

MULTIPLYING DECIMALS BY 10, 100, AND 1000

1. Multiply :

<u>2.7</u>	<u>.27</u>	<u>.27</u>	<u>2.7</u>	<u>.027</u>	<u>.0027</u>
10	10	100	100	1000	10000

2. Write a rule for multiplying a number by 10 ; by 100 ; by 1000.

Using this rule, name the answers in examples 3 to 7 at sight. Remember that in a whole number, as 25, the decimal point is understood to belong after units.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
3. $10 \times .05$	$10 \times .7$	$10 \times .75$	10×2.5
4. 10×36	$100 \times .08$	100×7.5	100×7.5
5. $10 \times .011$	$100 \times .7$	$100 \times .075$	1000×7.5
6. 10×7.26	$100 \times .008$	$100 \times .75$	$1000 \times .008$
7. $10 \times \$0.01$	$10 \times \$0.10$	$10 \times \$0.001$	$100 \times \$0.001$

8. How many dimes should be received in exchange for dollars?

9. Find the cost of 100 lb. of coal at \$0.01 a pound.

10. When William has collected 100 lb. of old newspapers, sells them at \$0.0125 a pound. What does he receive for 100 lb.

11. When coffee is offered in lots of 10 lb. at \$2.90, or at \$0.29 a pound, how much less will 10 lb. cost if bought at one time instead of a single pound at a time?

12. How much more does 100 lb. of chicken feed cost at \$0.36 a pound than a 100-lb. sack of it at \$3.60?

13. A junk dealer bought old iron at \$0.015 a pound and sold it in carload lots at \$0.0325 a pound. What did he gain on 100 lb. What did he gain on 1000 lb.?

PROBLEMS INVOLVING MULTIPLICATION OF DECIMALS

1. What were a carpenter's wages per hour if, after receiving increase of \$0.125, his wages were \$1 an hour? What were his wages for an 8-hour day before the increase? After the increase?
2. At \$0.07½ a pound what is the cost of 8 cwt. of sugar?
3. What was received for 16,000 U. S. Army blankets sold at .40 each?
4. At a "Navy Food Sale" 10,000 cans of California peaches were sold at \$0.335 a can. What was received for them?
5. Eleanor rode 16 times around a race track in ½ hr. The track measured .375 mi. At the same rate how many miles could she ride in an hour?
6. Last summer Mrs. Edwards bought 40 doz. eggs at \$0.45 a dozen and preserved them for use in winter. She paid \$0.50 a dozen for preserving material. What is her saving on the 40 doz., estimating the price of storage eggs in winter at \$0.60 a dozen?
7. Charles paid \$0.15 for a cut of ⅙ of a pumpkin pie. He found out that the cost of the pie was \$0.30 and the cost of serving was estimated at \$0.12. What was the profit on this pie?
8. In one year boys' and girls' clubs of Ohio produced 156,107 lb. of pork. What was its value at \$0.12½ a pound?
9. Mr. Jones sold ½ T. of cow beets at \$0.015 a pound. How much money did he receive for them?
10. The consumption of fats per person in the United States is estimated at 3.42 oz. per day. At this estimate how many pounds of fat would a family of four consume during April?
11. Clarence bought a pig at \$6.50. When it weighed 226 lb., he sold it at \$0.12½ a pound. If the feed for the pig cost \$10.75, how much money did Clarence clear?

DIVIDING A DECIMAL BY AN INTEGER

$$1. \ .6 \div 2 = \frac{6}{10} \div 2 = \frac{3}{10} = .3. \quad \text{Check: } 2 \times .3 = .6.$$

Find the quotients in examples 2 to 5 as the quotient in example 1 is found, and check:

$$2. \ .06 \div 3$$

$$3. \ .02 \div 5$$

$$4. \ .012 \div 4$$

$$5. \ .0015$$

6. In practice we find the quotients in examples 2 to 5 shown in *a*, *b*, *c*, and *d*. Look at these quotients and compare number of decimal places in the quotient with the number of decimal places in the dividend. Observe that the divisor in each example is an integer.

$$a. \begin{array}{r} 3 \overline{) .06} \\ \underline{.02} \end{array}$$

$$b. \begin{array}{r} 5 \overline{) .020} \\ \underline{.004} \end{array}$$

$$c. \begin{array}{r} 4 \overline{) .012} \\ \underline{.003} \end{array}$$

$$d. \begin{array}{r} 3 \overline{) .0015} \\ \underline{.003} \end{array}$$

7. Write a rule for placing the decimal point in the quotient when the divisor is an integer.

8. Compare the rule which you wrote with the rule given on page 104. Using the rule, find the quotients in examples 9 to 12:

$$a \quad 9. \begin{array}{r} 5 \overline{) .45} \end{array}$$

$$b \quad 5 \overline{) .025}$$

$$c \quad 6 \overline{) 0.72}$$

$$d \quad 7 \overline{) .0049}$$

$$e \quad 4 \overline{) .0012}$$

Before attempting to find the quotients asked for in examples 10 to 12, study how the quotient was found in part *b* of example 6.

$$10. \ 6 \overline{) 3}$$

$$4 \overline{) .75}$$

$$5 \overline{) 5.4}$$

$$8 \overline{) 4.2}$$

$$8 \overline{) 6.4}$$

$$11. \ 8 \overline{) 6.2}$$

$$9 \overline{) .414}$$

$$6 \overline{) 3.42}$$

$$7 \overline{) .021}$$

$$8 \overline{) 5.6}$$

$$12. \ 8 \overline{) .61}$$

$$6 \overline{) .312}$$

$$9 \overline{) 5.22}$$

$$6 \overline{) .003}$$

$$6 \overline{) 7.2}$$

3. Divide 8.8 by 7.

$$\begin{array}{r} \text{Thus, } 7 \overline{)8.80000} \\ \underline{1.25714^+} \end{array}$$

In practice the division is seldom carried beyond the fifth decimal place in quotient, which is usually expressed to the nearest ten-thousandth. Thus, $.25714^+$ expressed to the nearest ten-thousandth is 1.2571. If the quotient $.25716^+$, expressed to the nearest ten-thousandth, it is 1.2572. The sign at the quotient in example 13 indicates that the quotient expressed is not complete.

Find the quotients correct to the nearest hundredth:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
4. $6 \overline{)1.0}$	$9 \overline{)3.8}$	$6 \overline{)4.3}$	$9 \overline{)4.2}$	$9 \overline{)8}$	$7 \overline{)6}$
5. $7 \overline{)5}$	$9 \overline{)4}$	$6 \overline{)32}$	$9 \overline{)7}$	$11 \overline{)9.000}$	$7 \overline{)1}$

DIVIDING BY A DECIMAL

1. Find the quotients in these two examples: $6 \div 2$ and $60 \div 20$. Explain how they illustrate that *multiplying both dividend and divisor by the same number does not change the quotient*.

2. Instead of $.6 \div .2$ we may write $6 \div 2$. Why?

3. $.6 \div .2 = 6 \div 2 = 3$. Check: $3 \times .2 = .6$. Are these statements all true?

Divide as in example 3, and check:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
4. $.6 \div .3$	$.8 \div .4$	$.8 \div .2$	$1.2 \div .6$	$1.5 \div .5$
5. $1.8 \div .6$	$2.4 \div .4$	$2.4 \div .6$	$3.2 \div .8$	$3.2 \div .4$
6. $3.6 \div 1.2$	$9.6 \div 1.2$	$3.6 \div 1.8$	$4.5 \div 1.5$	$7.5 \div 2.5$

7. $4.56 \div .2 = 45.6 \div 2$. Why? We may find the quotient the same way:

$$\begin{array}{r} \text{Check: } 22.8 \\ \underline{.2)4.56} = \underline{2)45.6} \\ 22.8 \end{array} \qquad \begin{array}{r} 22.8 \\ \underline{.2} \\ 4.56 \end{array}$$

Find the quotients, first making the divisor a whole number and changing the dividend correspondingly, as in example 7. Check.

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
8.	$.3)\underline{.27}$	$.4)\underline{.56}$	$.7)\underline{.049}$	$.8)\underline{.056}$	$.9)\underline{.0}$
9.	$.4)\underline{.056}$	$.6)\underline{.036}$	$.06)\underline{.072}$	$.08)\underline{.064}$	$.07)\underline{.4}$
10.	$.05)\underline{1.25}$	$.005)\underline{.025}$	$.05)\underline{12.50}$	$.06)\underline{12}$	Write 00 after
11.	$.08)\underline{16}$	$.08)\underline{72}$	$.09)\underline{81}$	$.12)\underline{.144}$	$.12)\underline{1}$
12.	$.05)\underline{.50}$	$.5)\underline{.05}$	$.05)\underline{.005}$	$.005)\underline{.5}$	Write 00 after
13.	$.02)\underline{.2}$	$.002)\underline{.2}$	$.025)\underline{.5}$	$.006)\underline{1.2}$	$.008)\underline{2}$

DIVIDING BY A DECIMAL

Divide:

1. $.1596$ by $.42$ 2. 15.96 by $.0042$ 3. 1.596 by $.042$

Before dividing, we move the decimal point to the right in both dividend and divisor such a number of places as will make the divisor a whole number. Why will this not change the quotient?

1.	2.	3.
$.38$	3800	38
$.42)\overline{15.96} = 42)\overline{1596}$	$.0042)\overline{15.96} = 42)\overline{159600}$	$.042)\overline{1.596} = 42)\overline{1596}$
$\underline{126}$	$\underline{1260}$	$\underline{126}$
336	336	336
$\underline{336}$	$\underline{336}$	$\underline{336}$
	00	

Check:

$$.42 \times .38 = .1596$$

Check:

$$.0042 \times 3800 = 15.96$$

Check:

$$.042 \times 38 = 1.596$$

The number of decimal places in the divisor and the quotient must together equal the number of decimal places in the dividend (with one zero or more annexed if necessary; see example 2)

Before finding the quotients in examples 4 to 10, state at sight the number of decimal places in each quotient.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	
$.25 \overline{)6.25}$	$.025 \overline{)6.25}$	$.25 \overline{)0.00625}$	$.0025 \overline{)6.25}$	<i>Write 00 after .25.</i>
$.012 \overline{)1.44}$	$1.2 \overline{)0.144}$	$.012 \overline{)14.4}$	$.012 \overline{)144}$	<i>Write .000 after 144.</i>
$.036 \overline{)0.288}$	$3.6 \overline{).288}$	$.36 \overline{)28.8}$	$.036 \overline{)288}$	
$.24 \overline{)86.4}$	$.024 \overline{)0.864}$	$2.4 \overline{)8.64}$	$.024 \overline{)86.4}$	
$7.8 \overline{)32.76}$	$.78 \overline{).3276}$	$.78 \overline{)3.276}$	$.078 \overline{)32.76}$	
$8.9 \overline{)3.204}$	$.89 \overline{).3204}$	$.89 \overline{)0.3204}$	$.76 \overline{)1.558}$	
$.76 \overline{)15.58}$	$.76 \overline{).1558}$	$.76 \overline{)155.8}$	$.076 \overline{)0.1558}$	

PROBLEMS INVOLVING DIVISION OF DECIMALS

1. Fred's father drove his car 109.2 mi. on 6 gal. of gasoline. Find the average number of miles he made per gallon.
2. At a luncheon $\frac{1}{4}$ lb. of butter was served to 10 persons. The butter cost \$0.80 a pound. What was the cost of each portion?
3. In a county in Indiana 102 members of the garden club cultivated in one year 396,435 sq. ft. of garden. How many square feet was this per member, correct to the nearest tenth of a square foot?
4. It has been estimated that the farmer receives for the butter he sells about $\frac{2}{3}$ of the money which the consumer pays. At this estimate, how much does the farmer receive for a pound of butter which the consumer pays \$0.60? \$0.72? \$0.57? \$0.90?

5. A 10-acre field of hay on Mr. Ambler's farm yielded 12 tons. What was the yield per acre?

6. Find the cost of a cup of coffee, estimating 2 gal. of coffee from a pound of coffee beans at \$0.40 a pound, $\frac{1}{2}$ pt. of boiled coffee to the cup.

7. A contractor was paid \$60,000 for constructing a mile of improved road. This was how much per foot, correct to the nearest cent? 1 mi. = 5280 ft.

8. A French aviator with 2 passengers flew to an altitude of 19,685 ft. How many miles was this, correct to the nearest hundredth of a mile?

9. When Clare was 7 years old, her height was 45 in. and her weight 48 lb. When she was 12 years old her height was 55 in. and her weight 79 lb. Find her average yearly increase in height and in weight.

REDUCING COMMON FRACTIONS TO DECIMALS

Any common fraction may be reduced to a decimal.

1. Reduce $\frac{3}{8}$ to a decimal.

$$\text{Thus, } 8 \overline{)3.000} \\ \underline{.375}$$

REMARK If a fraction is in lowest terms and its denominator contains no prime factors other than 2's or 5's, the fraction can be reduced to a decimal like .375; but if the denominator contains prime factors other than 2's or 5's, the decimal which it equals ends in a common fraction; as, $.03\frac{1}{3}$.

Test each of these fractions to see that it may be reduced to a decimal which does not end in a common fraction; then reduce each to a decimal:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>
2.	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{8}$	$\frac{5}{8}$	$\frac{7}{20}$	$\frac{7}{25}$
3.	$\frac{3}{40}$	$\frac{7}{8}$	$\frac{3}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$
4.	$\frac{5}{16}$	$\frac{3}{80}$	$\frac{9}{40}$	$\frac{7}{16}$	$\frac{3}{25}$	$\frac{11}{16}$

5. Reduce $\frac{5}{6}$ to hundredths.

$$\text{Thus, } 6 \overline{)5.00} \\ .83\frac{1}{3}$$

Reduce these fractions to hundredths:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
6. $\frac{3}{8}$	$\frac{7}{16}$	$\frac{7}{30}$	$\frac{7}{15}$	$\frac{3}{16}$	$\frac{5}{16}$	$\frac{11}{30}$
7. $\frac{7}{12}$	$\frac{5}{12}$	$\frac{3}{22}$	$\frac{9}{28}$	$\frac{7}{80}$	$\frac{5}{24}$	$\frac{11}{48}$

8. Express $\frac{4}{9}$ as a decimal, correct to the nearest ten-thousandth.

Thus, $9 \overline{)4.00000}$
 $.44444^+ = .4444$, correct to the nearest ten-thousandth

Express as a decimal each of the following fractions, correct to nearest hundredth; correct to the nearest ten-thousandth:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
9. $\frac{4}{9}$	$\frac{7}{9}$	$\frac{2}{7}$	$\frac{7}{12}$	$\frac{22}{7}$	$\frac{20}{3}$	$\frac{7}{22}$
10. $\frac{11}{15}$	$\frac{3}{7}$	$\frac{1}{12}$	$\frac{5}{9}$	$\frac{1}{11}$	$\frac{7}{11}$	$\frac{5}{28}$

FINDING THE QUOTIENT TO A DESIRED DEGREE OF ACCURACY

In examples 1 to 3, find the quotients to the nearest hundredth. Annex zeros to the dividend when necessary.

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1. $.6 \overline{)2.53}$	$.6 \overline{)7.6}$	$.8 \overline{)0.21}$	$.09 \overline{)0.22}$
2. $.11 \overline{).8}$	$1.2 \overline{)7.6}$	$.24 \overline{)18.7}$	$3.6 \overline{)2.47}$
3. $.15 \overline{)7.6}$	$5.4 \overline{).8}$	$.72 \overline{)2.6}$	$.89 \overline{)1.16}$

In examples 4 and 5, express the quotients to the nearest ten-thousandth:

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
4. $.3 \overline{).02}$	$.03 \overline{)2.5}$	$.006 \overline{).0004}$	$.009 \overline{).2}$
5. $.15 \overline{).25}$	$26 \overline{)2.8}$	$33 \overline{).048}$	$49 \overline{)7.5}$

DIVIDING BY NUMBERS ENDING IN ZERO

1. Study carefully the following statements and then make a rule for dividing a number by 10; by 100; by 1000.

(a) $.7 \div 10 = \frac{7}{10} \div 10 = \frac{7}{100} = .07$; that is, $.7 \div 10 = .07$. Check.

(b) $.7 \div 100 = \frac{7}{10} \div 100 = \frac{7}{1000} = .007$; that is, $.7 \div 100 = .007$.

Check.

(c) $.7 \div 1000 = \frac{7}{10} \div 1000 = \frac{7}{10000} = .0007$; that is, $.7 \div 1000 = .0007$. Check.

2. Using the rule, name the quotients:

$.8 \div 10$ $7 \div 10$ $.06 \div 10$ $2.5 \div 10$ $.04 \div 10$

$.5 \div 100$ $6 \div 100$ $2.7 \div 100$ $32 \div 100$ $1.8 \div 100$

$65 \div 100$ $7.5 \div 100$ $32 \div 1000$ $56 \div 1000$ $7.5 \div 1000$

Divide:

3. 24 by 20. SUGGESTION: $24 \div 20 = 2.4 \div 2 = 1.2$. Explain.

The answer may also be found this way: $20 \overline{)24} = 2 \overline{)2.4}$
1.2

a

b

c

d

4. 36 by 20 42 by 20 48 by 30 54 by 60

5. 75 by 50 246 by 200 725 by 500 819 by 900

6. 276 by 2000 487 by 2000 5076 by 2000 4832 by 2000

United States Postage. All matter sent through the United States mails is divided into four classes, as follows:

First-class. Letters and sealed matter: 2 cents for each ounce or fraction of an ounce. Postal cards and post cards: 1 cent each.

Second-class. Newspapers and periodicals: 1 cent for each 4 ounces or fraction.

Third-class. Miscellaneous printed matter, weighing 4 pounds or less: 1 cent for each 2 ounces or fraction.

Fourth-class, Parcel Post. All mailable matter not included in first three classes.

Special Delivery. A special-delivery stamp (or 10 cts. in ordinary stamps when the letter or parcel is marked "Special Delivery") in addition to postage, secures immediate delivery within the carrier limits of city delivery offices between the hours of 7 A.M. and 11 P.M. and within 1 mile of all other United States post offices between the hours of 7 A.M. and 7 P.M.

Registered Mail. To insure the sender of a piece of mail against loss not exceeding \$50 (first-class mail) and \$25 (third-class mail), it may be registered. The rate is 10 cents on each piece in addition to the regular postage. A piece of registered mail must bear the name and address of the sender.

UNITED STATES POSTAGE

What is the postage on :

1. A letter weighing 2 oz.? $1\frac{1}{2}$ oz.? 5 oz.? $4\frac{1}{2}$ oz.?
2. A package of newspapers weighing 8 oz.? 7 oz.?
3. A magazine weighing 12 oz.? 10 oz.? 15 oz.?
4. What will it cost to send a special delivery letter weighing $\frac{1}{2}$ oz.? $\frac{3}{4}$ oz.?
5. Find the cost of sending a registered letter weighing $1\frac{1}{2}$ oz.; 1 $\frac{3}{4}$ oz.

Parcel Post. Fourth-class matter embraces that known as domestic parcel post mail, and includes merchandise, farm and factory products, seeds, cuttings, bulbs, roots, scions, and plants, books (including catalogues), miscellaneous printed matter weighing more than four pounds, and all other mailable matter not embraced in the first, second, and third classes.

Insurance. Fourth-class or domestic parcel post mail may be insured against loss for an amount equal to its actual value up to \$5 for a fee of 3 cents; \$25 for 5 cents; \$50 for 10 cents; or \$100 for 25 cents. These fees are in addition to the postage.

Rates of Postage on Fourth-class or Parcel Post Matter — To Be Fully Prepaid — Unsealed — are as follows :

(a) Parcels weighing 4 ounces or less, except books, seeds, plants, etc. 1 cent for each ounce or fraction thereof, any distance.

(b) Parcels weighing 8 ounces or less containing books, seeds, cutting bulbs, roots, scions, and plants, 1 cent for each 2 ounces or fraction thereof regardless of distance.

(c) Parcels weighing more than 8 ounces containing books, seeds, plants etc., parcels of miscellaneous printed matter weighing more than 4 pound and all other parcels of fourth-class matter weighing more than 4 ounces are chargeable, according to distance or *zone*, at the pound rates shown in the following table, a fraction of a pound being computed as a full pound :

WEIGHT IN POUNDS	LOCAL	ZONES							
		1st Up to 50 miles	2d 50 to 150 miles	3d 150 to 300 miles	4th 300 to 600 miles	5th 600 to 1000 miles	6th 1000 to 1400 miles	7th 1400 to 1800 miles	8th Over 1800 miles
1	\$0.05	\$0.05	\$0.05	\$0.06	\$0.07	\$0.08	\$0.09	\$0.11	\$0.12
2	.06	.06	.06	.08	.11	.14	.17	.21	.24
3	.06	.07	.07	.10	.15	.20	.25	.31	.36
4	.07	.08	.08	.12	.19	.26	.33	.41	.48
5	.07	.09	.09	.14	.23	.32	.41	.51	.60
and 1 cent for each additional 2 pounds or fraction thereof		and 1 cent for each additional pound or fraction thereof	and 1 cent for each additional pound or fraction thereof	and 2 cents for each additional pound or fraction thereof	and 4 cents for each additional pound or fraction thereof	and 6 cents for each additional pound or fraction thereof	and 8 cents for each additional pound or fraction thereof	and 10 cents for each additional pound or fraction thereof	and 12 cents for each additional pound or fraction thereof
Weight limit 70 pounds					Weight limit 50 pounds				

The local rate is applicable to parcels intended for delivery at the office mailing or on a rural route starting therefrom.

PARCEL POSTAGE PROBLEMS

What is the postage on a parcel weighing :

1. 8 ounces, containing a book? 7 ounces, containing a book
2. 5 ounces, containing seeds? $7\frac{1}{2}$ ounces, containing plants

3. 4 ounces, containing merchandise? 2 ounces, containing elry?

4. $1\frac{1}{2}$ ounces, containing merchandise? $2\frac{1}{2}$ ounces, containing licine?

From the table, state at sight the postage on the following:

WEIGHT OF PARCEL	DISTANCE CARRIED FROM OFFICE OF MAILING
5. 8 pounds	80 mi.; 1450 mi.; local.
6. 4 pounds	120 mi.; 2000 mi.; local.
7. 9 pounds	20 mi.; 700 mi.; local.
8. 12 pounds	36 mi.; 500 mi.; local.
9. 12 ounces	19 mi.; 1300 mi.; local.
10. $7\frac{1}{2}$ pounds	47 mi.; 1650 mi.; local.
11. 58 pounds	45 mi.; 175 mi.; local.
12. 70 pounds	125 mi.; 195 mi.; local.

✓
THRIFT

1. Make a list of the things for which you spent money last month. Check off on this list the things for which you spent money unwisely.

2. Here is a pupil's personal budget for one month; that is, a mailed statement of the pupil's expected receipts and proposed savings and expenditures. Fill in the totals:

DECEMBER			
<i>me</i>		<i>Savings</i>	\$2.00
<i>n hand</i>	\$1.50	<i>Expenditures</i>	
<i>lowance</i>	2.00	Skates	2.50
<i>ork</i>	3.75	Paints and Book	1.75
		Amusements	.35
		Sundries	.25
		Balance	.50
Total		Total	

3. At the end of this month, make a budget for the next month, and see how nearly you can live up to it. Report at the end of the month the effect of this budget on your expenditures.

4. In one year in the Northern and Western States, 1,120,810 boys and girls were engaged in one or more agricultural projects. The total valuation of all projects grown was \$6,019,092.26, and the cost of production was \$2,447,313.54. How much did the valuation of the projects grown exceed the cost of production? Was the average net profit for each child as much as \$3.00, or more than \$3.00?

5. If Floyd buys 4 thrift stamps each month, how many months will it take him to save \$5.00 in this way?

6. Andrew's father bought 8.2 T. of coal at \$13.50 a ton. By screening the ashes, he saved $\frac{1}{10}$ of the coal. The money saved would buy how many war savings stamps in April, and how much would be left?

7. In a school of 328 boys and 350 girls, $\frac{3}{4}$ of the boys and $\frac{2}{5}$ of the girls are saving by buying thrift stamps. They purchase on an average 1 thrift stamp per month each. How much does the school save in this way in ten months?

8. During August Charles saved 75¢ a day for 27 days. How many thrift stamps would these savings buy?

9. In one year it cost \$75,000 to repair the damage done by careless people in a New York park. This amount would pay for how many Liberty Bonds when they were sold at \$100 each? How many at \$50 each?

10. Daniel belongs to a club the members of which save the first day of each month, 2¢ the second day, 3¢ the third day and so on. How much does Daniel save in January? in February and March?

FARM PROJECTS

1. Here is an account of the expenditures and receipts of one acre of corn raised by a member of a corn club in the East. Find the net profit.

EXPENDITURES		RECEIPTS	
Land rental	\$ 8.00	6 bu. seed corn @	\$4.00
Preparation of soil	4.00	69 bu. corn @	1.50
Seed	.40	Fodder	10.00
Planting	.80		
Cultivation	3.42		
Hoeing and thinning	3.00		
Fertilizer	2.80		
Harvesting	11.20		
Miscellaneous	<u>.50</u>		

2. A grower in the South makes the following estimate of the cost and yield of one acre of sea island cotton in a recent year. Find the profit.

Cost

Plowing, man and team	1 day		\$ 8 00
Harrowing, man and team	$\frac{1}{2}$ day	\$ 8.00	
Scoring, man and team	1 day		8 00
Planting, man and team	$\frac{1}{2}$ day	8.00	
Seed, 1 peck			1 00
Cultivating, man and team	$3\frac{3}{4}$ days	8.00	
Picking, one man	8 days	1.80	
Hauling, man and team	$\frac{1}{2}$ day	8.00	
Ginning			10 00
Fertilizer	300 lb., per ton	80.00	

YIELD

250 lb. lint, per pound	\$.80		
650 lb. seed, per ton	90.00		

POULTRY FOOD

Egg-laying Ration. The following ration has been used with good results at a government experimental farm; read this ration and tell what it means:

MASH	SCRATCH MIXTURE
16 pounds corn meal	1 pound cracked corn
6.5 pounds meat scrap	1 pound wheat
1 pound bran	1 pound oats
1 pound middlings	

1. Multiply each weight given under "mash" by 12.25, and express each result to the nearest pound. The sum of these results is how many pounds of mash?

2. The mash should be $\frac{1}{2}$ of the ration; the remainder should be scratch mixture. How many pounds of scratch mixture should be used with 300 lb. of mash?

3. How many pounds of cracked corn are there in 120 lb. of scratch mixture? How many pounds of wheat? How many pounds of oats?

4. If a quantity of mash is made which contains 32 lb. of corn meal, how many pounds of meat scrap should be used? How many pounds of bran? How many pounds of middlings?

5. If it is desired to make $\frac{1}{2}$ the quantity of mash given in the ration, how many pounds of each ingredient which makes up the mash must be used? How many pounds of scratch mixture should be used with it? (See example 2.)

6. When 10 lb. of bran are used to make mash, how many pounds of each of the other ingredients used to make mash should be taken? How many pounds of mash will be made? How many pounds of scratch mixture must be used with it?

ACCURACY AND SPEED TEST IN ADDITION OF DECIMALS

Find the correct sums in these 6 examples in 6 minutes or less:

1.	2.	3.	4.	5.	6.
75	2.08	9.82	.09	107.56	9.28
36	1.78	8.76	.75	8.98	48.75
48	5.39	5.42	3.96	.37	3.20
32	2.17	9.87	14.28	52.56	.75
56	4.86	3.09	9.75	3.08	.35
28	.29	7.76	28.32	7.91	82.95
07	.48	1.85	5.90	.48	7.68
48	.70	2.09	87.65	47.25	248.90
76	1.89	.35	3.49	3.75	9.80
26	7.86	.75	8.48	28.46	176.25
26	9.12	4.08	93.04	.85	329.67
75	8.14	8.42	3.75	.92	5.85
03	.07	.14	.25	.16	.28
24	<u>.11</u>	<u>2.06</u>	<u>1.05</u>	<u>.04</u>	<u>10.01</u>

ACCURACY AND SPEED TEST IN SUBTRACTION OF DECIMALS

Find the correct differences in these 50 examples in 5 minutes less:

1.	.4	.4	.7	.56	.91	.5	.75	.8
	<u>.1</u>	<u>.35</u>	<u>.275</u>	<u>.29</u>	<u>.7</u>	<u>.207</u>	<u>.296</u>	<u>.486</u>
2.	.55	.8	.75	.9	.27	.8	.7	.56
	<u>.4</u>	<u>.25</u>	<u>.18</u>	<u>.201</u>	<u>.1</u>	<u>.561</u>	<u>.299</u>	<u>.488</u>
3.	.6	.75	.9	.75	.95	.8	.62	.901
	<u>.56</u>	<u>.28</u>	<u>.899</u>	<u>.5</u>	<u>.9</u>	<u>.709</u>	<u>.008</u>	<u>.899</u>
4.	.2	.57	.526	.32	.488	.9	.707	.5
	<u>.001</u>	<u>.445</u>	<u>.506</u>	<u>.209</u>	<u>.398</u>	<u>.009</u>	<u>.698</u>	<u>.408</u>

5.	$\begin{array}{r} .7568 \\ .1975 \\ \hline \end{array}$	$\begin{array}{r} .4 \\ .2756 \\ \hline \end{array}$	$\begin{array}{r} .38 \\ .2009 \\ \hline \end{array}$	$\begin{array}{r} .804 \\ .7956 \\ \hline \end{array}$	$\begin{array}{r} .9 \\ .2999 \\ \hline \end{array}$	$\begin{array}{r} .3006 \\ .2997 \\ \hline \end{array}$
6.	$\begin{array}{r} .8496 \\ .3214 \\ \hline \end{array}$	$\begin{array}{r} .7 \\ .4319 \\ \hline \end{array}$	$\begin{array}{r} .8001 \\ .7991 \\ \hline \end{array}$	$\begin{array}{r} 2.04 \\ .4968 \\ \hline \end{array}$	$\begin{array}{r} 60.04 \\ .753 \\ \hline \end{array}$	$\begin{array}{r} .4908 \\ .3999 \\ \hline \end{array}$
7.	$\begin{array}{r} .5 \\ .3111 \\ \hline \end{array}$	$\begin{array}{r} 7.0 \\ .6732 \\ \hline \end{array}$	$\begin{array}{r} .321 \\ .1007 \\ \hline \end{array}$	$\begin{array}{r} 80.01 \\ 1.896 \\ \hline \end{array}$	$\begin{array}{r} .78 \\ .0825 \\ \hline \end{array}$	$\begin{array}{r} .9009 \\ .8999 \\ \hline \end{array}$

ACCURACY AND SPEED TEST IN MULTIPLICATION OF DECIMALS

Find the correct products for 40 of these examples in 8 minutes

1.	$\begin{array}{r} .5 \\ .5 \\ \hline \end{array}$	$\begin{array}{r} .02 \\ .5 \\ \hline \end{array}$	$\begin{array}{r} .07 \\ .06 \\ \hline \end{array}$	$\begin{array}{r} .8 \\ .04 \\ \hline \end{array}$	$\begin{array}{r} .007 \\ .6 \\ \hline \end{array}$	$\begin{array}{r} .09 \\ .09 \\ \hline \end{array}$	$\begin{array}{r} .08 \\ .80 \\ \hline \end{array}$	$\begin{array}{r} 4.5 \\ .02 \\ \hline \end{array}$
2.	$\begin{array}{r} .003 \\ .03 \\ \hline \end{array}$	$\begin{array}{r} 3.7 \\ 3 \\ \hline \end{array}$	$\begin{array}{r} .9 \\ .009 \\ \hline \end{array}$	$\begin{array}{r} .201 \\ .7 \\ \hline \end{array}$	$\begin{array}{r} 8.2 \\ .04 \\ \hline \end{array}$	$\begin{array}{r} .008 \\ 1.2 \\ \hline \end{array}$	$\begin{array}{r} 7.5 \\ .005 \\ \hline \end{array}$	$\begin{array}{r} .028 \\ .09 \\ \hline \end{array}$
3.	$\begin{array}{r} 2.5 \\ .5 \\ \hline \end{array}$	$\begin{array}{r} 1.25 \\ .5 \\ \hline \end{array}$	$\begin{array}{r} .625 \\ .02 \\ \hline \end{array}$	$\begin{array}{r} .088 \\ .06 \\ \hline \end{array}$	$\begin{array}{r} 7.5 \\ 10 \\ \hline \end{array}$	$\begin{array}{r} 8.8 \\ 20 \\ \hline \end{array}$	$\begin{array}{r} .075 \\ 30 \\ \hline \end{array}$	$\begin{array}{r} .48 \\ 200 \\ \hline \end{array}$
4.	$\begin{array}{r} .12\frac{1}{2} \\ 8 \\ \hline \end{array}$	$\begin{array}{r} .06\frac{2}{3} \\ .6 \\ \hline \end{array}$	$\begin{array}{r} .08\frac{1}{3} \\ .09 \\ \hline \end{array}$	$\begin{array}{r} .37\frac{1}{2} \\ 10 \\ \hline \end{array}$	$\begin{array}{r} .62\frac{1}{2} \\ .8 \\ \hline \end{array}$	$\begin{array}{r} .33\frac{1}{3} \\ .06 \\ \hline \end{array}$	$\begin{array}{r} .66\frac{2}{3} \\ .09 \\ \hline \end{array}$	$\begin{array}{r} .87\frac{1}{2} \\ .4 \\ \hline \end{array}$
5.	$\begin{array}{r} .06 \\ .02\frac{1}{2} \\ \hline \end{array}$	$\begin{array}{r} .9 \\ .03\frac{1}{3} \\ \hline \end{array}$	$\begin{array}{r} .75 \\ .06\frac{2}{3} \\ \hline \end{array}$	$\begin{array}{r} 4.8 \\ .08\frac{1}{3} \\ \hline \end{array}$	$\begin{array}{r} .32 \\ .04\frac{1}{2} \\ \hline \end{array}$	$\begin{array}{r} 6.4 \\ .03\frac{3}{4} \\ \hline \end{array}$	$\begin{array}{r} 6.6 \\ 10\frac{2}{3} \\ \hline \end{array}$	$\begin{array}{r} 9.9 \\ .33\frac{1}{3} \\ \hline \end{array}$
.	$\begin{array}{r} .08 \\ .06\frac{1}{4} \\ \hline \end{array}$	$\begin{array}{r} .12 \\ .04\frac{1}{3} \\ \hline \end{array}$	$\begin{array}{r} .18 \\ .06\frac{2}{3} \\ \hline \end{array}$	$\begin{array}{r} .24 \\ .08\frac{1}{3} \\ \hline \end{array}$	$\begin{array}{r} .36 \\ .06\frac{2}{3} \\ \hline \end{array}$	$\begin{array}{r} 1.5 \\ .33\frac{1}{3} \\ \hline \end{array}$	$\begin{array}{r} .24 \\ .66\frac{2}{3} \\ \hline \end{array}$	$\begin{array}{r} .36 \\ .37 \\ \hline \end{array}$

ACCURACY AND SPEED TEST IN DIVISION OF DECIMALS

Find the correct quotients in these 60 examples at the rate of a minute; check results:

1. $2)\underline{.04}$ $.4)\underline{.4}$ $.4)\underline{.08}$ $.04)\underline{.8}$ $.4)\underline{8}$ $.004)\underline{8}$
2. $10)\underline{.4}$ $20)\underline{.4}$ $.8)\underline{.4}$ $.08)\underline{.4}$ $.08)\underline{.004}$ $.5)\underline{.1}$
3. $.5)\underline{.001}$ $.01)\underline{.5}$ $.6)\underline{1.2}$ $.06)\underline{.3}$ $.3)\underline{.006}$ $.7)\underline{21}$
4. $.009)\underline{8.1}$ $1.2)\underline{.6}$ $.08)\underline{.04}$ $.25)\underline{.05}$ $2.5)\underline{.5}$ $.025)\underline{5}$
5. $.8)\underline{.01}$ $.008)\underline{1}$ $.001)\underline{.7}$ $2.5)\underline{.075}$ $1.6)\underline{32}$ $32)\underline{1.6}$
6. $.4)\underline{10}$ $1.6)\underline{.08}$ $20)\underline{1}$ $40)\underline{.8}$ $.8)\underline{.004}$ $.008)\underline{.4}$
7. $.001)\underline{.1}$ $.01)\underline{.001}$ $100)\underline{.2}$ $4)\underline{.012}$ $.16)\underline{.4}$ $4.8)\underline{24}$
8. $5)\underline{.6}$ $.8)\underline{.0064}$ $1.6)\underline{.8}$ $.5)\underline{.01}$ $.05)\underline{.8}$ $.005)\underline{.6}$
9. $.2\frac{1}{2})\underline{.5}$ $.02\frac{1}{2})\underline{.7\frac{1}{2}}$ $.5)\underline{.2\frac{1}{2}}$ $.12\frac{1}{2})\underline{25}$ $.12\frac{1}{2})\underline{2.5}$ $.3\frac{1}{3})\underline{.06\frac{2}{3}}$
10. $.1\frac{1}{4})\underline{.02\frac{1}{2}}$ $.02\frac{1}{2})\underline{10}$ $10)\underline{.7\frac{1}{2}}$ $.33\frac{1}{3})\underline{6.6\frac{2}{3}}$ $.7\frac{1}{2})\underline{1.5}$ $.07\frac{1}{2})\underline{1.5}$

REVIEW OF DECIMALS

. Show that multiplying a number by .1 has the same effect as dividing it by 10.

. Show that multiplying a number by .01 has the same effect as dividing it by 100.

. Dividing a number by 1000 has the same effect as multiplying it by what number?

. State the products:

$$\begin{array}{llll} \times 25 & .1 \times \$7.50 & .1 \times 50 \text{ lb.} & .1 \times \$0.50 \end{array}$$

5. State the products:

$.01 \times 25$	$.01 \times \$25$	$.01 \times \$7.50$	$.01 \times 250 \text{ lb}$
$.01 \times \$500$	$.01 \times 60 \text{ sec.}$	$.01 \times 240 \text{ bu.}$	$.01 \times 50 \text{ gal}$

6. Is this statement correct? Moving the decimal point one place to the left multiplies a number by .1. Prove your answer.

7. Is this statement correct? Moving the decimal point two places to the left multiplies a number by .01. Prove your answer.

8. Express each of these fractions as a decimal in hundredths then learn the *decimal equivalent* of each:

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{3}{5}$	$\frac{4}{5}$	$\frac{1}{10}$
$\frac{2}{3}$	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{5}{8}$	$\frac{7}{8}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{1}{12}$

9. Express each decimal as a common fraction and then name each product:

$.25 \times 8$	$.20 \times 80$	$.75 \times 20$	$.60 \times 2$
$.50 \times 15$	$.40 \times 30$	$.80 \times 45$	$.30 \times 6$
$.12\frac{1}{2} \times 16$	$.33\frac{1}{3} \times 15$	$.16\frac{2}{3} \times 24$	$.37\frac{1}{2} \times 4$
$.87\frac{1}{2} \times 24$	$.83\frac{1}{3} \times 12$	$.08\frac{1}{3} \times 36$	$.62\frac{1}{2} \times 5$

10. Express each of the following as a part of a dollar and then learn what you have stated:

10¢	25¢	50¢	85¢	30¢
75¢	80¢	90¢	60¢	20¢
40¢	70¢	$33\frac{1}{3}\%$	$66\frac{2}{3}\%$	$37\frac{1}{2}\%$
$87\frac{1}{2}\%$	$62\frac{1}{2}\%$	$16\frac{2}{3}\%$	$8\frac{1}{3}\%$	$41\frac{2}{3}\%$

11. If there are 3 decimal places in the multiplicand and 2 decimal places in the multiplier, how many should there be in the product?

12. Supply the missing words: Since $\text{divisor} \times \text{quotient} = \dots$, the number of decimal places in the divisor plus the number of decimal places in the quotient equals the number of decimal places in the product.

decimal places in the . . . must equal the number of decimal places in the

13. How many decimal places should there be in the quotient when there are 6 in the dividend and 4 in the divisor? 5 in the dividend and 2 in the divisor? 4 in the dividend and 4 in the divisor?

14. Read, stating the result at sight:

$.2 + .02$	$.25 + .04$	$.1 + .01$	$.1 + .001$
$.08 + .006$	$.25 + .008$	$.1 - .01$	$.9 - .09$
$.08 - .02$	$.07 - .005$	$.8 - .08$	$1 - .01$
$.08 - .002$	$.3 \times 6$	$.3 \times .3$	10×3.5
$.00 \times 3.75$	$3 \div 100$	$\$2.75 \div 10$	$3.6 \div 6$
$3.1 \div 9$	$.45 \div 5$	$100 \times .03$	$86 \div 100$
$.00 \times .6$	$1000 \times .36$	$200 \div 1000$	$.1 \times 32$
$7\frac{1}{2} \times 16$	$.12\frac{1}{2} \times 8$	$10 \times .045$	$.01 \times 100$
$10 \times \$2.50$	$90 \div 1000$	$.8 \div .4$	$.12 \div .04$
$20 \times .3$	$4.8 \div 6$	$.01 \div .1$	$.1 \div .01$
$1 \div .1$	$.5 \div 5$	$.02 \div .1$	$.001 \times 100$
$7\frac{1}{2} \times 16$	$.33\frac{1}{3} \times 9$	$.66\frac{2}{3} \times 6$	$.08\frac{1}{3} \times 60$

15. It is estimated that each person in the United States uses 7 lb. of beef in a year and 103.5 lb. of pork. At this estimate, how much of both does a family of five consume in a year?

16. One foot is .3048 *meters*. What is the length of a yard in meters? of a rod?

17. One kilometer is 0.62137 of a mile. If an army marched 100 kilometers to reach a certain town, how many miles did it march?

18. If a dealer buys sweet potatoes at \$1.50 per $\frac{5}{8}$ -bushel basket and sells them at \$0.23 per $\frac{1}{4}$ peck, what is his profit per basket?

19. About 4.4 lb. of butter are obtainable from 100 lb. of whole milk. How many pounds of butter are obtainable from 1000 lb. of whole milk? What weight of butter from 1 lb. of whole milk?

20. The average composition of one pound of butter as determined from many samples and as given by the U. S. Department of Agriculture is as follows; add these weights:

Butter fat	.8241 lb.
Water	.1390 lb.
Salt	.0251 lb.
Curd	<u>.0118 lb.</u>

NOTE. Butter fat is the principal constituent of butter; it is the pure oil contained in milk, cream, and butter.

21. Using the facts stated in example 20, find how many pounds of butter fat there are in 100 lb. of butter; how many pounds of water; of curd; of salt.

22. In a period of six months there were purchased at M. Dickinson's creamery 17,210 lb. of butter fat, from which 20,250 lb. of butter were made. How many pounds of butter were made from each pound of butter fat? Answer correct to the nearest hundredth of a pound.

23. A vessel that is sailing 18.5 knots an hour is sailing how many miles an hour, 1 knot being equal to 1.152 mi.?

24. State a short way of multiplying a decimal by 100. Illustrate.

25. State a short way of dividing a decimal by 100. Illustrate.

26. Find the cost of shipping 278 lb. of dry goods from Chicago to Toledo at \$0.37 per 100 lb.; from Chicago to your shipping point.

27. If 30 A. of cotton produce 4.5 T. of seed, what is the average yield per acre? If the seed is sold at \$70 a ton, how much is received for the yield from the 30 A.? From the yield from each acre?

28. Mary's mother wished to buy her a coat, the regular price of which was \$24, but instead she had Mary's old coat cleaned and pressed at a cost of \$2.25. Later she was able to buy the \$24 coat at a reduction of $\frac{1}{3}$ from the regular price. How much money did she save?

29. Mr. Levy advertised a sale of men's shoes thus: "Regular price \$10.50, special price \$7." The reduction was what part of the regular price? The special price was what part of the regular price?

30. A bushel contains 2150.42 cu. in. How many cubic inches are there in $\frac{1}{4}$ pk., correct to the nearest hundredth?

31. A man retailed apples at \$1.50 a bushel, or 30¢ per $\frac{1}{2}$ peck. How much more did he receive for a bushel when sold by the $\frac{1}{2}$ peck than when sold by the bushel?

32. In some places anthracite coal is sold by the bushel, which weighs 75 lb. How many bushels should be given for a ton of 2000 lb., correct to the nearest tenth bushel? How many bushels should be given for a ton of 2000 lb., correct to the nearest tenth bushel?

33. Mr. Moore bought 4 automobile tires, guaranteed for 6000 miles. He paid \$21.35 each. Find correct to the nearest hundredth of a cent the tire cost per mile, based on this guarantee.

34. My car can make 16 mi. on a gallon of gasoline. The cost is \$0.32 a gallon. How much per mile if the price of gasoline is \$0.32 a gallon? How much will the gasoline cost me which I will need on a trip of 136 mi.?

35. It is estimated that it would take 5,000,000 A. to produce grain what the rats of this country destroy of property in one year, each acre producing \$40 worth of grain. What is our money loss from rats in one year?

36. Walter read in a catalogue that the "official" national league ball sells for \$15 per dozen. At this rate what was the cost of each ball?

37. In \$111.111, for what sum of money does each 1 stand? Counting from the right, the second 1 has a value equal to how many times the first 1? Compare the value of each of the other 1's with the value of the 1 next to it on the right. Compare the value of each 1 after the first to the left with the 1 next to it on the left.

38. Each person in the United States consumes about 90 lb. of sugar a year. If during one year sugar costs \$0.08½ a pound, and another \$0.26 a pound, what is the difference in the cost of the sugar for a family of five in the two years?

39. If Mrs. Crawford boils a 4-lb. piece of meat and throws away the fat, what is the money loss if each pound of meat yields .0625 lb. of fat worth \$0.24 a pound?

40. A boy's suit was reduced to \$12.50, which was $\frac{2}{3}$ of the regular price. What was the regular price?

41. A cubic foot of iron weighs 486.75 lb. Iron is 7.788 times as heavy as water. What is the weight of a cubic foot of water?

42. Find the cost of 1000 paper fasteners at \$0.25 per C.

43. A farmer sowed 6.25 bu. of wheat, and the yield was 78.1 bu. What was the yield for each bushel sowed?

44. The weight of dressed hogs is about .80 of their live weight. What should be the dressed weight of a hog whose live weight is 375 lb.?

45. Floyd's father deals in vegetables. He bought potatoes \$1.80 per 100 lb. How much was that a pound? How much a bushel (60 lb.)? He sold them at \$0.20 per $\frac{1}{2}$ peck. What was his profit on a bushel?

46. If your father owns property valued at \$10,000 and pays support of the schools 4 mills each year for every dollar of this amount, how much does he pay each year for the support of the schools?

47. What is paid for the butter fat in a pound of butter, when .50 is paid for a pound of butter fat, and butter is .8241 butter fat?

48. A newspaper printed an offer of the following prizes to be awarded in a needlework contest. Find the total amount of the prizes offered:

First prize	\$25
Second prize	15
Third prize	10
Fourth, five prizes of \$5 each	
Ten \$3-prizes	
Fifteen \$2-prizes	
Ten \$1-dollar prizes	
Total	

REVIEW OF WHOLE NUMBERS, FRACTIONS, AND DECIMALS

1. Write the largest decimal you can, using only the figures 1, 3, and 4, and using each but once; write the least.

2. A mile is 1.6093 kilometers. How many kilometers are there in 10 mi.? in 100 mi.? in 1000 mi.?

3. At \$0.036 a mile, what is the railroad fare of two persons if they travel by train 256 mi.?

4. Anna paid \$0.20 for a box of 100 paper fasteners. How much is that for each?

5. A price of \$180 a ton for sugar is what price per 100 lb.? What price per pound?

6. Divide .04 by .1, then multiply .04 by 10. Compare the answers and state a short way of dividing by .1.

7. Name the answers: $.03 \div .1$; $.4 \div .1$; $6 \div .1$; $65 \div .1$.
8. Divide $.04$ by $.01$, then multiply $.04$ by 100 . Compare the answers and state a short way of dividing by $.01$.
9. Name the answers: $.007 \div .01$; $.06 \div .01$; $.5 \div .01$.
10. For a salad for 60 people the following were bought and used; find, correct to the nearest tenth of a cent, the cost of serving each person:

24 lb. dressed chicken, per pound	\$0.45
10 lb. veal, per pound	.35
$1\frac{1}{2}$ bunches celery, per bunch	.90
1 gal. mayonnaise dressing, per quart	1.00

11. In an experiment it was found that each leghorn pullet consumed 0.4 lb. of food for each egg produced, and that the average yield for the year was 138 eggs per pullet. How much feed did each pullet consume in a year?

12. Simplify: $\frac{60.75}{2.25 \times .045}$. 13. Simplify: $\frac{.5 \times 6.25}{.125 \times .25}$. (Cancel)

14. Beef scraps for poultry can be bought at the rate of 5 lb. for 50¢, or 100 lb. for \$7. How much is gained if 100 lb. is bought at one time instead of in separate lots of 5 lb. each?

15. If James is paid \$3.60 for working 8 hr., how much should he be paid for working from 9 A.M. to 12 noon and from 2 P.M. to 5 P.M.?

16. If Elsie's father, who is a carpenter, receives \$7.20 for an 8-hour day, and is paid $1\frac{1}{2}$ times his regular wages for each hour he works overtime, how much should he receive for working from 7 A.M. to noon, and from 12.30 P.M. to 5.30 P.M.?

17. What profit is made on a gross (12 doz.) of erasers bought at \$6.40 and sold at \$0.10 each?

18. Estimating the weight of 10 eggs at 1 pound, what are eggs selling for per pound when the price is \$0.60 per dozen?

19. Calves lose about .4 of their weight in dressing. What is the dressed weight of a calf whose live weight was 150 lb.?
20. Missouri produces in one year about 65,000 bales of cotton of 500 lb. each and 35,000 tons of cottonseed. Estimating the cotton at \$0.35 a pound and the cottonseed at \$40 a ton, what is the value of Missouri's production of cotton for one year?
21. During one year the producers of cotton in Missouri received but \$0.0682 a pound for cotton and \$22 a ton for cottonseed. Taking the yield given in example 20, how much less money did the producers receive than they would have received at the prices given in example 20?
22. There are 12 dozen in a gross. If the crayon used in your school costs 30¢ a gross, what is the cost of each piece correct to the nearest tenth of a mill?
23. A *centimeter* is 0.3937 of an inch. How many inches are there in 10 centimeters?
24. An inch is 2.54 centimeters. How many centimeters are there in a foot?
25. Two bushels of hair are used for each coat of 100 sq. yd. of plastering. How many bushels of hair are needed to give 960 sq. yd. of surface two coats of plaster?
26. Mr. Clark told Warren that the expense of preparing his acres for wheat were as follows:
- Plowing, man and team, $6\frac{1}{2}$ da. at \$8.00 a day
Harrowing three times, man and team, 21 hr. at \$0.80 an hour
- Warren found what the expenses were and the expense per acre. What were his answers?
27. Texas contains 265,896 sq. mi. and Rhode Island 1248 sq. mi. Texas is how many times as large as Rhode Island? Answer correct to the nearest tenth.

28. Mr. Harris bought a bushel of clover seed for \$28. When it was tested, it was found to contain only .8 of a bushel of good seed. What did he pay per bushel for good seed?

29. Name the results: $\$0.10 \div 10$; $\$0.10 \div .1$; $.1 \times \$0.10$; $10 \times \$0.10$.

30. A hank of worsted yarn contains 560 yd. How many yards of worsted yarn are there in a pound of the kind that comes 16 hanks to the pound?

31. In an experiment with a flock of 1000 leghorn pullets it was found that the number of eggs produced in a year was 170 per bird, and that the cost of feed was \$2.19 per bird; the eggs were sold at an average of \$0.46 per dozen. What were the profits on the eggs above the feed cost?

32. Multiply 12345679 by 4×9 , or 36; then by 5×9 , or 45; then by 6×9 , or 54. Compare these three products. What will the product be if 12345679 is multiplied by 7×9 ? by 8×9 ? Test.

33. In a school it was found that out of 300 pupils examined 72 had defective teeth. How many pupils per 100 examined had defective teeth? State a rule for the care of the teeth that every boy and girl should observe.

34. Scratch feed for poultry was advertised as follows: 100 lb. \$4.75; 25 lb., \$1.25; 10 lb., \$0.60; 5 lb., \$0.35. How much less was the price for 100 lb. bought at one time than if bought in 25-lb. lots? in 10-lb. lots? in 5-lb. lots?

35. How many pounds of butter can be made from 100 lb. of whole milk which is found to yield .04 of its weight in butter fat if $1\frac{1}{8}$ lb. of butter are made from 1 lb. of butter fat?

36. Simplify: $\frac{6 \times 5}{2.5}$. (Cancel) 37. Simplify: $\frac{12.5 \times 3}{2.5}$. (Cancel)

38. How many yards of raw silk yarn are there to the pound if 256 skeins make a pound and each skein contains 1000 yd.?

39. A milk bottle marked *one pint* was found to contain only 25 cu. in. How many cubic inches short was it? (1 gal. = 231 cu. in.)
40. Mr. Thomas sold 200 bu. of potatoes at \$1.20 per $\frac{5}{8}$ -bushel basket. How much did he receive for them?
41. The average estimated value of the dwellings on 50 farms in southeastern Pennsylvania is \$3306 and of the outbuildings, \$3186. What is the estimated value of all the buildings on these farms?
42. Simplify: $\frac{2.5 \times .625}{5 \times .125 \times 10}$. (Cancel)
43. Simplify: $\frac{50 \times 2.5 \times .375}{.125 \times .625}$. (Cancel)
44. What is $\frac{1}{8}$ of 24? What is $.125 \times 24$? Why should the two results be equal?
45. George, William, and Frank together have 40 rows of vegetables. George has 20 rows, William 12 rows, and Frank 8 rows. What part of the 40 rows does each boy have? Frank's number is what part of George's? What part of William's? George's number is how many times William's? How many times Frank's?
46. Find each one's share if 50¢ is given to three boys, A, B, and C, so that A receives 5¢ as often as B receives 3¢ and C receives 2¢.
- SUGGESTION. 50¢ is to be divided into 5+3+2 equal parts, of which A receives 5 parts, B 3 parts, and C 2 parts.
47. If 60¢ is given to A, B, and C so that A receives 10¢ each, B receives 6¢ and C receives 4¢, how much does each receive?
48. If the retail price of American cheese is 30¢ a pound when the wholesale price is 24¢, how much is the retail price above the wholesale price? The difference is what part of the retail price? What part of the wholesale price? The wholesale price is what part of the retail price?

49. Express each of the fractions $\frac{5}{9}$, $\frac{6}{11}$, $\frac{7}{13}$, and $\frac{8}{15}$ as a decimal correct to the nearest thousandth; then write the fractions according to their value, the least first.

50. Write 4 mills as a decimal part of a dollar and find how many times it is contained in \$12.80.

51. Name four numbers which will contain 16.

52. Find the three equal factors of 216; of 1000.

53. If you know the distance around a garden of four sides and the length of three of the sides, how can you find the length of the fourth side?

54. A family that uses on an average 8 eggs a day uses how many dozen eggs a week? What is the outlay for a week's supply when eggs are 60¢ a dozen?

55. A builder estimates that $3\frac{1}{2}$ lb. of fourpenny nails are used in roofing for each 1000 shingles. At this estimate, how many pounds of nails are required if 18,000 shingles are used?

56. What profit is made on 2000 envelopes bought at 40¢ hundred and sold at 1¢ each?

57. Norman's father earns \$100 a month. Carol's father earns \$22.50 a week. Which earns the more in a year, and how much counting 52 weeks to the year?

58. It is estimated that 10 bu. (56 lb.) of corn and 10 bu. (32 lb.) of oats ground together should provide sufficient ground feed for a cow for 120 da. How many pounds of ground feed does this provide for a cow for 1 da.?

59. Wisconsin produces about 8,900,000,000 lb. of milk a year. It is estimated that .431 of the milk produced in the United States is used in liquid form, .41 of it is used for making butter, .05 for making cheese, .029 of it for condensed milk, .037 of it for ice cream, and .043 of it for feeding calves. At this estimate, how much of the Wisconsin product is used in each of the ways named?

CHAPTER IV

PERCENTAGE

MEANING OF PER CENT

1. Mr. Adams planted 200 fruit trees, but 10 out of *every hundred* of them did not grow. How many did not grow?

2. In a school of 500 children, 8 out of *every hundred* had "perfect" in every study. How many had "perfect" in every study?

3. A contractor bought 800 bricks. In shipping them, 6 out of *every hundred* were broken. How many were broken in shipping them?

In problems like 1, 2, and 3, instead of saying so many out of *every hundred*, or so many *hundredths*, we may say so many *per cent*. The expression *per cent* is a short form of the Latin expression *per centum*, and means *by the hundred*, or *per hundred*, *hundredths*.

4. Read and solve problems 1, 2, and 3, saying so many *per cent* instead of so many out of *every hundred*.

The symbol % stands for *per cent*.

Thus, for 6 *per cent* we may write 6%.

5. Read the following as per cents; then write each, using the symbol %:

$\frac{5}{100}$	$\frac{45}{100}$	$\frac{8}{100}$	$\frac{10}{100}$	$\frac{50}{100}$	$\frac{75}{100}$	$\frac{100}{100}$
$\frac{6\frac{1}{4}}{100}$	$\frac{8\frac{1}{3}}{100}$	$\frac{125}{100}$	$\frac{7\frac{1}{2}}{100}$	$\frac{200}{100}$	$\frac{250}{100}$	$\frac{62\frac{1}{2}}{100}$
.05	.45	.08	.10	.50	.75	1.00
$.06\frac{1}{4}$	$.08\frac{1}{3}$	1.25	$.07\frac{1}{2}$	2.00	2.50	$.62\frac{1}{2}$

EQUIVALENTS — PER CENT, DECIMAL, AND FRACTIONAL

1. Write each of the following as a fraction and as a decimal thus, for the first, write $2\% = \frac{2}{100} = .02$.

2% 5% 45% 8% 10% 50% 75% 100%
 $12\frac{1}{2}\%$ $6\frac{1}{4}\%$ $8\frac{1}{3}\%$ 125% $7\frac{1}{2}\%$ 200% 250% $62\frac{1}{2}\%$

2. $25\% = .25 = \frac{25}{100}$, or $\frac{1}{4}$. Therefore, we may write $25\% = .25 = \frac{1}{4}$.

3. Write each of the following as a decimal and as a common fraction in lowest terms, as in example 1:

20% 10% 80% 30% 40% 50% 70% 90%
 5% 15% 75% 60% 45% 55% 85% 65%

4. Since $37\frac{1}{2}\% = .37\frac{1}{2}$ or $\frac{37\frac{1}{2}}{100} = \frac{75}{200} = \frac{3}{8}$, we may write $37\frac{1}{2}\% = .37\frac{1}{2} = \frac{3}{8}$.

5. Write each of the following as a decimal and as a common fraction in lowest terms:

$12\frac{1}{2}\%$ $62\frac{1}{2}\%$ $87\frac{1}{2}\%$ $6\frac{1}{4}\%$ $33\frac{1}{3}\%$ $66\frac{2}{3}\%$
 $6\frac{2}{3}\%$ $8\frac{1}{3}\%$ $14\frac{2}{7}\%$ $11\frac{1}{9}\%$ $16\frac{2}{3}\%$ $22\frac{2}{9}\%$

6. Express each of the following as a per cent:

$\frac{1}{2}$ $\frac{1}{4}$ $\frac{1}{5}$ $\frac{3}{4}$ $\frac{3}{5}$ $\frac{4}{5}$ $\frac{1}{20}$ $\frac{1}{25}$ $\frac{1}{3}$
 .05 .25 .35 .04 .06 .75 .60 .80 .4

7. Express each of the following as a per cent:

$\frac{1}{8}$ $\frac{3}{8}$ $\frac{5}{8}$ $\frac{7}{8}$ $\frac{1}{3}$ $\frac{2}{3}$ $\frac{1}{6}$ $\frac{1}{10}$

Thus, for $\frac{1}{8}$ we may think: Since $1 = \frac{100}{100}\%$, or 100%, $\frac{1}{8} = \frac{1}{8}$ of 100% or $12\frac{1}{2}\%$.

$12\frac{1}{2}\%$ $37\frac{1}{2}\%$ $62\frac{1}{2}\%$ $87\frac{1}{2}\%$ $33\frac{1}{3}\%$ $66\frac{2}{3}\%$ $16\frac{2}{3}\%$.08

8. Memorize this table:

$50\% = \frac{1}{2}$	$20\% = \frac{1}{5}$	$12\frac{1}{2}\% = \frac{1}{8}$	$33\frac{1}{3}\% = \frac{1}{3}$
$25\% = \frac{1}{4}$	$40\% = \frac{2}{5}$	$37\frac{1}{2}\% = \frac{3}{8}$	$66\frac{2}{3}\% = \frac{2}{3}$
$75\% = \frac{3}{4}$	$60\% = \frac{3}{5}$	$62\frac{1}{2}\% = \frac{5}{8}$	$16\frac{2}{3}\% = \frac{1}{6}$
$100\% = 1$	$80\% = \frac{4}{5}$	$87\frac{1}{2}\% = \frac{7}{8}$	$8\frac{1}{3}\% = \frac{1}{12}$

FINDING A GIVEN PER CENT OF A NUMBER

1. Find 20% of 40.

SUGGESTION. 20% of 40 = $\frac{1}{5}$ of 40 = ?

Find :

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
2. 20% of 15	25% of 16	50% of 6	25% of 9
3. 20% of 25	60% of 30	70% of 40	90% of 60
4. 25% of 28	5% of 60	4% of 75	40% of 10
5. 5% of \$100	25% of \$12	75% of \$8	35% of 40

6. Find $37\frac{1}{2}\%$ of 24.

SUGGESTION. $37\frac{1}{2}\%$ of 24 = $\frac{3}{8}$ of 24 = ?

Find :

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
7. $12\frac{1}{2}\%$ of 16	$37\frac{1}{2}\%$ of 8	$62\frac{1}{2}\%$ of 24	$87\frac{1}{2}\%$ of 40
8. $33\frac{1}{3}\%$ of 21	$66\frac{2}{3}\%$ of 15	$16\frac{2}{3}\%$ of 18	$8\frac{1}{3}\%$ of 60
9. $12\frac{1}{2}\%$ of \$24	$37\frac{1}{2}\%$ of \$6	$62\frac{1}{2}\%$ of \$32	$33\frac{1}{3}\%$ of \$15
10. $66\frac{2}{3}\%$ of \$9	$16\frac{2}{3}\%$ of \$30	$8\frac{1}{3}\%$ of \$36	$87\frac{1}{2}\%$ of \$0.80

FINDING A GIVEN PER CENT OF A NUMBER

1. Name at sight 50% of each of the following numbers ; then % of each ; then 75% of each ; then 100% of each :

16 4 20 32 40 28 10

2. Name at sight $33\frac{1}{3}\%$ of each of the following numbers ; then $66\frac{2}{3}\%$ of each ; then 100% of each :

9 21 30 24 15 18 10

3. Name at sight $12\frac{1}{2}\%$ of each of the following numbers ; then $37\frac{1}{2}\%$; then $62\frac{1}{2}\%$; then $87\frac{1}{2}\%$; then 100% :

16 40 24 56 32 48 64

4. How many quarts are there in 25% of a gallon? 50% of a gallon? 75% of a gallon?

5. How many cents are there in 10% of a dollar? 25% of a dollar? 20% of a dollar? 40% of a dollar? 60% of a dollar? what part of a dollar?

6. How many quarts are there in $12\frac{1}{2}\%$ of a peck? $37\frac{1}{2}\%$ of a peck? $87\frac{1}{2}\%$ of a peck? $62\frac{1}{2}\%$ of a peck? 50% of a peck? what part of a peck?

7. $200\% = \frac{200}{100}$, or 2. Express each of the following as an integer:

300% 100% 500% 400% 600% 700% 1000%

8. Find 200% of 6.

SUGGESTION. 200% of $6 = 2 \times 6 = ?$

9. Name 200% of each of these numbers:

8 10 1 3 6 9 7 $\frac{1}{2}$ $\frac{1}{4}$

10. Name 300% of each number in example 9; 400% of each; 100% of each; 500% of each; 700% of each; 800% of each; 1000% of each.

11. $125\% = \frac{125}{100} = \frac{5}{4}$. Express each of the following as a fraction in lowest terms:

120% 150% 160% 110% 180% 225% 250%

12. Find 125% of 16.

SUGGESTION. 125% of $16 = \frac{5}{4}$ of $16 = ?$

13. Find 150% of 6; 10; 20; 2; 3; 30; 5; 7; 25; .4; 40

14. Find 125% of \$4; \$8; \$16; \$20; \$40; $\frac{1}{2}$; $\frac{1}{4}$; .4; .08.

15. Find 150% of 100 in.; of 250 lb.; of 360 A.

FINDING A GIVEN PER CENT OF A NUMBER

1. What is the reduction on an article sold at 20% off the regular price, when the regular price is \$1.00? 50¢? \$5.00? 60¢? 5¢? \$10.00? \$6.00?

2. Benson was given 20 words to spell. He spelled 100% of them correctly. How many did he spell correctly?
3. Cora's Christmas savings amounted to \$12. She spent $\frac{1}{3}$ % of them for a fountain pen and 25% of them for gifts. How much did she spend for a fountain pen? for gifts? for both?
4. Count this way: 1% of 100 is 1, 2% of 100 is 2, and so on 10% of 100 is 10.
5. Count this way: 1% of 200 is 2, 2% of 200 is 4, and so on 10% of 200 is 20.
6. Name at sight 1% of \$600; of 500 bu.; of 200 ft.; of 300.
(Remember what you learned in example 1, page 190.)
7. If you know 1% of a number, how can you find in a short way 2% of it? 3% of it? 4% of it? 5% of it?
8. Name 1%, then 2%, then 3%, then 4%, then 10%, of:
100 300 men 800 lb. 500 tons 1000 oz. \$150 \$250
9. Jane sold 644 Red Cross Christmas seals and Helen sold % as many as Jane. How many did Helen sell? How many both sell?
- To find the number that Helen sold we may multiply 644 by .75 or take $\frac{3}{4}$
10. Try both ways. Which way do you prefer?
11. A baseball team collected \$120.50 and spent 60% of it for suits. How much was spent for suits?
12. The residents of a town gave \$625 in one year for children's playgrounds and gardens; 68% of this amount was spent for playgrounds and 20% of it on gardens. The remainder was carried over for the next year. How much was carried over?
13. On a rainy day 5% of the 40 pupils in the sixth grade were absent. How many were present?

FINDING A GIVEN PER CENT OF A NUMBER

1. Read the following, using a common fraction in lower terms instead of each *per cent*: "The United States produces 20% of the world's supply of gold, 25% of its supply of wheat, 40% of its supply of iron and steel, 60% of cotton, 75% of the supply of corn, and $66\frac{2}{3}\%$ of its supply of oil."

2. If you had 50 words in a spelling test and were marked 98% how many words did you spell correctly?

3. If a dealer buys shoestrings at 5¢ a pair and sells them at 200% of cost, what does he receive for them?

4. Hugh planted a peck of potatoes and the yield was 1500%. How many bushels did the peck yield?

5. Instead of using $5\frac{1}{2}\%$ we may use .055. Show that the statement is true.

SUGGESTION. $5\frac{1}{2}\% = \frac{5\frac{1}{2}}{100}$. Multiply both terms of the fraction by 10.

6. Instead of using $3\frac{3}{4}\%$, we may use .0375. Show that the statement is true.

7. Instead of using 3.3%, we may use .033. Show why.

8. Reduce these per cents to decimals:

50%	25%	$7\frac{1}{2}\%$	$12\frac{1}{2}\%$	$37\frac{1}{2}\%$	$62\frac{1}{2}\%$
$87\frac{1}{2}\%$	2.7%	6.5%	.3%	$6\frac{1}{8}\%$	.5%

9. How much is 3.5% of \$1.00? 3.65% of 1000 lb.? $12\frac{1}{2}\%$ of 1000 T.?

10. Good milk contains about 87% water, 4% fat, 5% milk sugar, 3.3% casein and albumen, and .7% mineral matter. How many pounds of each are there in 100 pounds of good milk?

11. Potatoes are about 75% water and 16.2% starch, by weight. How many pounds of water in a bushel (60 lb.) of potatoes of starch? What per cent is neither water nor starch?

12. 10% of all U. S. silver coin is copper alloy. Find the weight of the copper and also of the silver in a silver dollar, the weight of which is 412.5 grains.

13. In a schoolroom the light area should be 20% of the floor space. If the floor space is 1200 sq. ft., what should be the light area?

FINDING A NUMBER WHEN A PER CENT OF IT IS GIVEN

1. Instead of saying 50% of John's savings is \$7, we may say *John's savings is \$7*. If $\frac{1}{2}$ of John's savings is \$7, how much money has he saved?

2. State what the number is if 50% of it is:

5 8 $\frac{1}{2}$ $2\frac{1}{2}$ 3 10 $7\frac{1}{2}$

3. If 25% of Andrew's crop of tomatoes was 12 baskets, how many baskets of tomatoes were there in his crop? Use what action for 25%?

4. State what the number is if 25% of it is:

5 3 2 $\frac{1}{2}$ $\frac{1}{4}$ 2.5 $\frac{3}{4}$

5. Instead of saying 75% of the games played were won, we may say $\frac{3}{4}$ of the games played were won. If 12 games were won, we may say $\frac{3}{4}$ of the number of games played = 12. How many games were played?

6. State what the sum is if 75% of it is:

\$6 \$9 12¢ 15¢ 21¢ 30¢

7. 2 pounds is $12\frac{1}{2}\%$ of what weight? 10% of what weight?

8. 3 yards is 20% of what length? 25%? $33\frac{1}{3}\%$?

9. 8 pounds is 40% of what weight? 80%? $12\frac{1}{2}\%$?

10. 1¢ is 50% of what sum? $12\frac{1}{2}\%$? 25%? 20%?

11. Read, stating the missing numbers:

$$2 \text{ qt.} = 50\% \text{ of } \dots \text{ qt.} \qquad 1 \text{ ft.} = 33\frac{1}{3}\% \text{ of } \dots \text{ yd.}$$

$$2 \text{ qt.} = 25\% \text{ of } \dots \text{ pk.} \qquad 1 \text{ pk.} = 25\% \text{ of } \dots \text{ bu.}$$

$$1 \text{ pt.} = 50\% \text{ of } \dots \text{ qt.} \qquad 2 \text{ pk.} = 5\% \text{ of } \dots \text{ bu.}$$

12. Instead of saying *200% of Mildred's savings are \$12*, we may say *2 times Mildred's savings are \$12*. If 2 times her savings are \$12, what are her savings?

13. If a dealer sold a diamond for \$200, which was 200% the cost, what was the cost?

14. If a pie sold for \$0.50, which was 200% of the cost, what was the cost?

15. Richard spelled 18 words correctly and was given a grade of 90%. How many words was he given to spell? How many did he misspell?

FINDING A NUMBER WHEN A PER CENT OF IT IS GIVEN

1. Since $5 \times 3 = 15$, it is evident that $15 \div 5 = 3$ and that $15 \div 3 = 5$. From this statement we see that if the product of two factors is given and also one of the factors, we may find the other. State how.

Find the missing numbers in examples 2 to 7.

2. If $5 \times \text{a number} = 15$, the number $= 15 \div 5 = ?$

3. If $4 \times \text{a number} = 12$, the number $= 12 \div 4 = ?$

4. If $\frac{1}{4} \times \text{a number} = 6$, the number $= 6 \div \frac{1}{4} = ?$

5. If $.25 \times \text{a number} = 6$, the number $= 6 \div .25 = ?$

6. If 20% of a number $= 12$, the number $= 12 \div .20 = ?$

7. Find the number of which 96 is 16%.

SUGGESTION. $.16 \times \text{the number} = 96$
 $96 \div .16 = \text{the number}$

$$\begin{array}{r} .16 \overline{)96.00} \\ \underline{16} \\ 80 \\ \underline{80} \\ 00 \\ 00 \\ 00 \end{array}$$

In examples 8 to 13 find the number of which :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
8.	24 is 12%	45 is 15%	48 is 16%	63 is 35%
9.	66 is 22%	96 is 24%	75 is 15%	72 is 36%
10.	132 is 25%	225 is 75%	450 is 90%	630 is 70%
11.	6 is 6%	125 is 20%	88 is 88%	19 is 95%
12.	49 is $87\frac{1}{2}\%$	150 is $33\frac{1}{3}\%$	25 is $12\frac{1}{2}\%$	75 is $62\frac{1}{2}\%$
13.	96 is $12\frac{1}{2}\%$	$66\frac{2}{3}$ is $33\frac{1}{3}\%$	$\frac{1}{2}$ is 20%	$\frac{3}{4}$ is 50%
14.	\$2.50 is 25% of what amount? 15% of what amount?			
15.	\$6.80 is 5% of what amount? 4% of what amount?			
16.	\$10.50 is 3% of what amount? $3\frac{1}{2}\%$ of what amount?			
17.	If 4%, by weight, of milk is butter fat, how many pounds of milk will yield 50 lb. of butter fat?			
18.	If Mr. Allen spends \$728 for food for his family and this amount is 20% of his yearly wages, what are his yearly wages?			
19.	If the health inspector found that 144 children in a school needed medical attention and these were 48% of all the children enrolled, how many children were enrolled?			

FINDING WHAT PER CENT ONE NUMBER IS OF ANOTHER

- What part of 8 is 4? What per cent of 8 is 4?
 $4 = \frac{1}{2}$ of 8, or 50% of 8.
- What part of 6 is 3? What per cent of 6 is 3?
- What part of 12 is 4? What per cent of 12 ft. is 4 ft.?
- What part of 15 is 5? What per cent of 15 yd. is 5 yd.?
- What part of 18 is 6? What per cent of 18 in. is 6 in.?

What per cent of :

*a**b**c**d*

6. 8 is 2?

8 is 1?

12 is 8?

32 is 4?

7. 12 is 9?

32 is 8?

18 is 12?

24 is 21?

8. 40 is 25?

50 is 40?

80 is 30?

36 is 3?

9. 1 pint is what per cent of a quart? of a gallon?

10. What per cent of a dollar is 3¢? 4¢? 5¢? 10¢? 25¢?

11. What per cent of a dozen is 6? 4? 3? 8? 2? 1?

12. What per cent of a number is 2 times the number? 3 times the number? $1\frac{1}{2}$ times the number? 1.25 times the number?

13. What per cent of a pint is a quart?

14. What per cent of a quart is a gallon? What per cent of a pint is a gallon?

15. What per cent of the games played did a basket ball team win which won 12 and lost none? which won 8 and lost 4? which won 6 and lost 6? which won 3 and lost 9? which won 2 and lost 10?

16. If James spelled correctly 49 of the 50 words given in a spelling test, what per cent of the words did he spell correctly?

17. What per cent of \$100 is \$5? \$8? \$12? \$2? \$12.50? \$7.50? \$8.75? \$3.25? \$3.80?

FINDING WHAT PER CENT ONE NUMBER IS OF ANOTHER

1. What per cent of 360 is 72?

$$\begin{array}{r} 3.6 \overline{)72.0} \\ 20 \end{array}$$

$$1\% \text{ of } 360 = .01 \times 360 = 3.6.$$

$$72 \div 3.6, \text{ or } 20 = \text{the required number of per cent.}$$

Ans. 20%

Compare the way example 1 is worked above with the following way and then work your examples by the method you prefer.

$$\begin{array}{r} 360 \overline{)72.00} \\ .20 \end{array}$$

$$\text{Some number} \times 360 = 72; \text{ therefore,}$$

$$.20 = 20\% \quad 72 \div 360, \text{ or } .20 = \text{the number. Then the answer is } 20\%.$$

In examples 2 to 5 find what per cent of :

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
2.	225 is 90	280 is 70	350 is 14	1000 is 125
3.	128 is 32	105 is 42	225 is 15	310 is 186
4.	\$648 is \$54	\$350 is \$63	\$480 is \$144	\$78.50 is \$15.70
5.	\$306 is \$34	\$250 is \$25	\$268 is \$13.40	\$3.85 is \$0.77
6.	If the population of a town increased in 10 years from 2400 to 2556, what was the per cent of increase?			

2556	$.01 \times 2400$, or $24 =$ the increase at 1%.
2400	$2556 - 2400$, or $156 =$ the increase in 10 years.
$24 \overline{)156.0}$	$156 \div 24 = 6.5$
6.5	6.5% is the required rate.

7. If a can of 60 lb. of milk yields 2.46 lb. of butter fat, what was the per cent of butter fat in this milk?

8. If 63 families in a town of 420 families have automobiles, what per cent of the families of that town have automobiles? What per cent do not have automobiles?

9. A school building which has 1600 sq. ft. of floor space has 20 sq. ft. of light area. The light area is what per cent of the floor space?

10. If a baseball team in a season won 102 games and lost 48, what was the per cent of games won?

11. If the families of the United States waste \$7.50 worth of food out of every \$100 worth bought, what per cent of the money spent for food is wasted?

12. If a carpenter's wages are advanced from 80¢ to \$1 an hour, what is the per cent of advance on 80¢?

13. When a plumber's wages are reduced from \$1.20 to \$1 an hour, what is the per cent of decrease on \$1.20?

THE THREE PROBLEMS OF PERCENTAGE

It is very necessary now to understand clearly the relationship of the three problems of percentage just studied. The first problem (see page 213) is finding a certain per cent of a number. The second problem (see page 217) is finding a number when a per cent of it is given. The third problem (see page 219) is finding what per cent one number is of another. **In each of these problems there are three numbers involved, two of which are given and the third required.**

You have had other problems in which similar relationships are involved; for example:

Find the cost of 5 acres of land at \$80 an acre. The answer is \$400. If you are given any two of the numbers involved in this problem, you can find the third. Thus, $5 \times \$80 = \400 ; $\$400 \div 5 = \80 ; $\$400 \div \$80 = 5$.

Again this relationship is evident in the following: (1) What is $\frac{1}{10}$ of 40? (2) 4 is $\frac{1}{10}$ of what number? (3) What part of 40 is 4? These three questions may evidently be changed to the following: (1) What is 10% of 40? (2) 4 is 10% of what number? (3) What per cent of 40 is 4?

Study the following examples as you solve them so that you may see clearly this relationship.

Supply the missing numbers at sight:

- | | | |
|-----------------------------------|-------------------------------|------------------|
| 1. 25% of 8 is ... | 2 is 25% of ... | 2 is ...% of 8 |
| 2. 10% of 20 is ... | 2 is 10% of ... | 2 is ...% of 20 |
| 3. 50% of 6 is ... | 3 is 50% of ... | 3 is ...% of 6 |
| 4. 20% of 15 is ... | 3 is 20% of ... | 3 is ...% of 15 |
| 5. 5% of 40 is ... | 2 is 5% of ... | 2 is ...% of 40 |
| 6. 40% of 25 is ... | 10 is 40% of ... | 10 is ...% of 25 |
| 7. 60% of 45 is ... | 27 is 60% of ... | 27 is ...% of 45 |
| 8. $12\frac{1}{2}\%$ of 48 is ... | 6 is $12\frac{1}{2}\%$ of ... | 6 is ...% of 48 |

REVIEW OF PERCENTAGE

1. We may write $1\% = .01 = \frac{1}{100}$; also, $2\frac{1}{2}\% = .025 = \frac{25}{1000} = \frac{1}{40}$. Express as a decimal and as a fraction in lowest terms:

2% 4% 5% 10% 20% 40% 60% 80% 25%
50% 70% 90% 75% $12\frac{1}{2}\%$ $37\frac{1}{2}\%$ $62\frac{1}{2}\%$ $87\frac{1}{2}\%$ $7\frac{1}{2}\%$

2. We may write $16\% = .16$; also, $7.5\% = .075$. In the same way express each of the following per cents as a decimal:

4% 12% 15% 18% 28% 42% 65% 82%
3.5% 4.5% 3.65% 4.75% 8.6% 8.72% 6.56% 5.25%

3. Express as a fraction in lowest terms: $33\frac{1}{3}\%$; $66\frac{2}{3}\%$; $6\frac{2}{3}\%$; $8\frac{1}{3}\%$; $6\frac{2}{3}\%$; $87\frac{1}{2}\%$; $62\frac{1}{2}\%$; $37\frac{1}{2}\%$.

4. Name the answers at sight:

5% of 16	$12\frac{1}{2}\%$ of 24	$16\frac{2}{3}\%$ of 18	$87\frac{1}{2}\%$ of 40
0% of 10	$33\frac{1}{3}\%$ of 6	$66\frac{2}{3}\%$ of 12	$62\frac{1}{2}\%$ of 40

Read, supplying missing amount or number:

5. \$5 = 25% of ...	\$14 = $87\frac{1}{2}\%$ of ...	40 = 5% of ...]
6. \$2 = 50% of ...	\$0.50 = $33\frac{1}{3}\%$ of ...	50 = 4% of ...
7. \$4 = $12\frac{1}{2}\%$ of ...	\$2 = $66\frac{2}{3}\%$ of ...	50 = 1% of ...
8. \$6 = $37\frac{1}{2}\%$ of ...	\$10 = $62\frac{1}{2}\%$ of ...	50 = 2% of ...
9. 1 is ...% of 10	10 is ...% of 50	12 is ...% of 48
10. 3 is ...% of 20	20 is ...% of 60	$12\frac{1}{2}$ is ...% of 100
11. 3 is ...% of 5	40 is ...% of 60	$7\frac{1}{2}$ is ...% of 100
12. 8 is ...% of 40	4 is ...% of 32	2.5 is ...% of 100
13. $62\frac{1}{2}\%$ of 16 is ...	10 is $62\frac{1}{2}\%$ of ...	10 is ...% of 16
14. $87\frac{1}{2}\%$ of 32 is ...	28 is $87\frac{1}{2}\%$ of ...	28 is ...% of 32
15. 200% of 9 is ...	18 is 200% of ...	18 is ...% of 9
16. 6% of \$200 is ...	\$12 is 6% of ...	\$12 is ...% of \$200
17. 7% of \$300 is ...	\$21 is 7% of ...	\$21 is ...% of \$300

18. The children of Grade 6 had a test of 50 words to spell. Frank had 50 right; Anna had 49 right; Helen had 45 right; Clarence had 48 right; Marian had 46 right; Edward had 47 right. What per cent of the 50 words did each child have right? What per cent of the 50 words did each child have wrong?

19. Mr. Carroll has two cows, Bess and Beauty. During June Bess gave 720 lb. of milk, which tested 4.1% butter fat. Beauty gave 910 lb., which tested 3.5% butter fat. Which cow produced the more butter fat in June?

REVIEW

1. Mr. Britton's wages are \$40 a week. He saves 15% of his wages. How much does he save each week? The rest of his wages are spent for family expenses. What per cent of his wages go for family expenses? What are these expenses for one week?

2. The trolley fare in Dorothy's town was increased from 5¢ to 7¢. What was the per cent of the increase?

3. Edna can buy 25 school tickets for \$1. The single fare is 7¢. How much will she save on 25 fares by buying a school ticket? What per cent of the cost of the school ticket will she save?

4. .0725 expressed as per cent is 7.25%. Express each of these decimals as per cent:

.0125 .2215 .075 .0282 .07

5. There are about 1.8 lb. of fat in 100 lb. of oats. What is the per cent of fat in oats?

6. If railroad companies increase the fare from 3¢ a mile to 3.6¢ a mile, what is the per cent of increase?

7. If the plumbers of a city were receiving \$1.25 an hour and their wages were reduced 20%, what did they then receive?

8. By careful selection and care of his poultry, a man brought the average yearly yield from his flock, from 120 eggs per bird to 180 eggs. What was the per cent of increase?

9. If the rainfall for August in Warren's city was 5.94 in., and for September only $16\frac{2}{3}\%$ of this amount, what was the rainfall in this city for September?

10. The temperature on a certain day increased from 60° at 8 A.M. to 80° at 1.30 P.M. Express this increase in per cent.

11. Supply the missing numbers, as in the first line:

\$7.50 is 7.5% of \$100; 7.5¢ is 7.5% of 100¢
 \$12.50 is ...% of \$100; 12.5¢ is ...% of 100¢
 \$1.50 is ...% of \$100; 1.25¢ is ...% of 100¢

12. In a test of 20 words marked on the basis of 100%, what per cent should be given for each word spelled correctly?

13. Name a coin that is 200% of a nickel; 500% of a nickel; 1000% of a quarter dollar; 1000% of a cent.

14. Jacob bought a second-hand book for \$0.60. The book cost \$1.50 when new. The price paid was what per cent of the price of the book when new? What per cent less than the price of the new book?

15. If 90% of the pupils of a sixth-grade room had the correct answer to a test problem, 8% of them the wrong answer, and the remainder of the class handed in no answer, what per cent of the class handed in no answer?

16. Pure gold is designated as *24 carats fine*. What is the per cent of pure gold in a class ring that is 12 carats fine? 18 carats fine?

17. In a test of 10 examples in arithmetic, what per cent of them did a pupil have right who had 9 right? 6 right? 8 right? 5 right?

18. Mr. Addison learned that the half cantaloupe for which he paid 20¢ cost but 5¢. He paid what per cent of the cost?

19. In another restaurant a half cantaloupe which cost but 5¢ was served at 30¢. This was what per cent of the cost?

20. What is the advance in price when sugar is increased from 8¢ to 26¢ a pound? What is the per cent of advance?

21. A \$45 overcoat was reduced to \$25. What was the per cent of reduction on \$45?

22. What per cent reduction was allowed on a \$50 suit that was sold at \$37?

Trade Discount. John read this statement in a catalogue: "League Uniforms, single suit \$12.50, discount to clubs ordering for entire team, 20%." John found out what this meant and what each suit for the entire team would cost at the offer here made. Can you tell what it means and what each suit would cost?

List Price. Standard prices are fixed for various commodities usually by manufacturers, publishers, or wholesale dealers. These prices, called *list prices*, are set forth in printed lists or catalogues. Goods on sale at retail stores are usually *marked* at the price at which the retailer expects to sell them. Reductions are sometimes made on *list price*, or *marked price*, as for cash payment, buying in large quantities, also on special sales, and to attract trade.

Net Price. Any reduction made from the list price, time price, or marked price is called *trade discount*, or *commercial discount*. The sum remaining after deduction of the trade discount is the *net amount* of the bill, or the *net price*.

FINDING DISCOUNT AND NET COST

At a reduction of 20%, state the discount and the net price of

1. A ring marked \$50.

2. Curtains marked \$4.

3. A boy's suit marked \$15.

4. A girl's sweater marked \$8.

5. A box of candy marked \$1.
7. Catcher's mitt marked \$2.50.
9. Set of dishes marked \$45.
11. An overcoat marked \$60.
13. A picture marked \$12.
15. A pair of blankets marked \$9.
17. State the discount in each of examples 1 to 16 if the reduction is 10%; 50%.
18. Which would you prefer: to buy a hat at \$6 with 20% off, or the same hat at \$4.50 with no discount?
6. A tennis racket marked \$3.
8. Tennis shoes marked \$4.50.
10. A book marked \$1.50.
12. A bedroom set marked \$100.
14. A tennis net marked \$6.
16. A bicycle marked \$40.

In examples 19 to 28, name at sight each discount and net cost:

<i>List Price</i>	<i>Rate of Discount</i>	<i>List Price</i>	<i>Rate of Discount</i>
19. \$20	20%	20. \$90	16 $\frac{2}{3}$ %
21. \$50	50%	22. \$75	20%
23. \$24	33 $\frac{1}{3}$ %	24. \$32	12 $\frac{1}{2}$ %
25. \$16	37 $\frac{1}{2}$ %	26. \$12	8 $\frac{1}{3}$ %
27. \$3.50	20%	28. \$100	40%

FINDING RATE OF DISCOUNT

In examples 1 to 10, name at sight the rate of discount:

<i>List Price</i>	<i>Net Cost</i>	<i>List Price</i>	<i>Net Cost</i>
1. \$4	\$3	2. \$10	\$8
3. \$6	\$4	4. \$10	\$5
5. \$9	\$6	6. \$16	\$14
7. \$20	\$19	8. \$20	\$18
9. \$40	\$38	10. \$100	\$98

PROBLEMS IN TRADE DISCOUNT

1. Find the net cost of a bill of goods amounting to \$420 and sold at a discount of 15%.

$$\begin{array}{r}
 \$420 = \text{the amount of the bill} \\
 .15 \\
 \hline
 2100 \\
 420 \\
 \hline
 \$63.00 = \text{the discount}
 \end{array}$$

\$420 - \$63, or \$357 = the net cost of the bill

2. Find the net cost of a bill of hardware amounting to \$380 on which there was a discount of 5% allowed; 20%.

3. Find the net cost of an automobile listed at \$3500 and sold at a discount of 15%; 25%.

4. Chester bought a bicycle for \$48 and after using it six months, sold it to William at a discount of $33\frac{1}{3}\%$. After William had used it four months, he sold it to James at a discount of 25%. What did James pay for the bicycle?

5. The gas company in Frank's city allows its customers a discount of 8% on all monthly bills paid on or before the tenth of the following month. Frank's father always makes payment in time to receive this discount on his monthly bills. Find what he saved by this discount on bills which for the first six months of a year were:

\$5.50

\$5.20

\$4.92

\$4.06

\$3.68

\$4.92

In the net bill for each month, disregard all fractions of a cent less than 5 mills, calling 5 mills or more a cent.

6. After Christmas a merchant marked sleds at a discount of 25%. What did Robert pay for a "flexible flyer," the regular price of which had been \$6.75?

7. Helen read in a catalogue that lily plants such as she wanted could be bought at \$1.00 each, and that a discount of $16\frac{2}{3}\%$ could be allowed if 6 were ordered and 25% if 12 were ordered. What would Helen have to pay for 6 lily plants? for 12?
8. If the regular price of the arithmetic which Casper uses is \$.60 and the publishers allow his school district a discount of 9% , what did 675 of these books cost the school district?
9. Mr. Smith decided to buy a \$2500 automobile, but before he made the purchase, it was reduced 20% . He bought it at the reduced price and was allowed a further discount of 10% on this price for cash payment. What did he pay for the automobile?
10. Candy marked 80¢ a box was marked down to 70¢. What was the rate of discount? At the same rate of discount, what could be charged for a box of candy marked \$1.20?
11. Watch the advertisements in the newspapers and when you see one in which goods are offered at a discount, bring it to class and show the class how to make and solve problems from this advertisement.

PROFIT AND LOSS — INTRODUCTORY EXERCISE

1. During "Old Home Week" Fred sold lemonade. His sales amounted to \$40. The cost of the lemonade was \$12, and the cost of running his lemonade stand (*overhead charges*) was \$8. Study these and the following statements and supply the missing numbers:

\$40 - \$12, or \$..., was Fred's **gross profit**.

\$40 - (\$12 + \$8), or \$..., was Fred's **net profit**.

REMARK. \$40 - (\$12 + \$8) means that the sum of \$12 and \$8 is to be subtracted from \$40.

2. What must be subtracted from the selling price of an article to find the gross profit? What must be subtracted from the selling price to find the net profit?

Besides the actual cost of goods bought and sold, there are generally other items of expense called **overhead charges**; for example, freight charges, storage, operating expenses, and so on.

If the selling price of goods is less than the cost (including overhead charges), the goods are sold at a *loss*.

3. Fred's net profit (see example 1) was what per cent of the cost of the lemonade plus overhead charges? What per cent of the selling price of the lemonade?

The per cent of profit or loss is sometimes reckoned on the cost (including overhead charges) and sometimes on the selling price.

REMARK. In this book, unless it is otherwise stated, the per cent of profit or loss is reckoned on the *cost*, which as used here includes overhead charges.

4. If the weather had been unfavorable and Fred's receipts from his stand had been but \$16 while the cost of the lemonade and overhead charges remained the same, what per cent of the cost (amount paid for lemonade plus overhead charges) would his loss have been? What per cent of the selling price?

PROBLEMS IN PROFIT AND LOSS

1. State at sight the gain or loss and the selling price:

Cost 5¢	gain 20%	Cost \$1.50	gain 10%
Cost 10¢	loss 10%	Cost \$1.75	loss 20%
Cost 15¢	gain $33\frac{1}{3}\%$	Cost \$6.06	gain $16\frac{2}{3}\%$
Cost 30¢	gain $66\frac{2}{3}\%$	Cost \$7.20	loss $37\frac{1}{2}\%$
Cost 32¢	loss $12\frac{1}{2}\%$	Cost \$6.40	gain $62\frac{1}{2}\%$
Cost \$1	gain 100%	Cost \$9.90	loss $11\frac{1}{9}\%$
Cost \$20	loss 5%	Cost \$7.70	gain $14\frac{2}{7}\%$
Cost \$40	gain $62\frac{1}{2}\%$	Cost \$16.00	loss $87\frac{1}{2}\%$

2. Find the selling price of a pair of shoes that cost \$4.80 sold at a profit of $62\frac{1}{2}\%$.

3. Mr. Weber sold sugar that cost 8¢ a pound at a loss of 25%. What was his loss on 100 lb. of this sugar?
4. What was the selling price of shoestrings which cost 5¢ a pair and which were sold at a profit of 100%?
5. Mr. Ray bought sweaters at \$3 each and placed them on sale at an advance of 50% on the cost. What was the regular selling price? He sold some of the sweaters at 20% off the regular selling price. What did he receive for each of these?
6. What does a dealer receive per peck for potatoes if they cost him \$1.50 a bushel and he is retailing them at a price which is $3\frac{1}{3}\%$ above cost? How much money does he gain on 100 bushels?
7. A grocer sells cheese that cost him 30¢ a pound at a price which allows him a profit of $33\frac{1}{3}\%$. How many ounces of cheese could he sell for 10¢?

PROBLEMS IN PROFIT AND LOSS

1. A dealer wishes to make a profit of 40% on coal for which he paid \$6.50 a ton. At what price must he sell it if the overhead charges are \$2 a ton?

$$\begin{array}{r}
 \$6.50 = \text{the price paid per ton} \\
 \underline{2.00} = \text{the overhead charges} \\
 \$8.50 = \text{the entire cost per ton} \\
 \underline{.40} \\
 \$3.40 = \text{the profit} \\
 \underline{8.50} \\
 \$11.90 = \text{the selling price per ton}
 \end{array}$$

2. A grocer paid \$70 for 1000 lb. of sugar. What must he sell for per pound to gain 25% if the overhead charges are 1¢ per pound?
3. If the gain on a box of candy that sold for \$1.50 was $33\frac{1}{3}\%$ the selling price, what did the dealer pay for it?

4. If an automobile cost a dealer \$1150, what must he receive for it to gain 25% if the overhead charges are \$110?

5. A grocer bought a crate of cantaloupes at \$2.40; the overhead charges were 60¢. Some of the cantaloupes spoiled, and he sold the lot at a loss of 25%. What did he receive for them?

6. What must be the selling price of oranges per dozen if they cost \$0.38 and the dealer wishes to make a profit of 40%, the overhead charges being 2¢ per dozen oranges?

7. Find out and tell the class what these words mean as they are generally used: *producer, consumer, retailer, wholesaler, middle man.*

8. Mr. Grant bought bacon from a wholesaler at 28¢ a pound. What must he sell it for per pound to gain 37½%, if the overhead charges are 4¢?

FINDING GAIN OR LOSS PER CENT

1. Name at sight the gain per cent:

Cost	Gain	Cost	Gain	Cost	Gain
1¢	1¢	\$2	\$1	\$ 1	\$ 1.2
2¢	1¢	\$2	\$3	\$ 2	\$ 3.0
1¢	2¢	\$5	\$4	\$ 8	\$ 7.0
5¢	2¢	\$8	\$7	\$ 9	\$ 9.0
8¢	1¢	\$6	\$10	\$12.50	\$ 6.2
2¢	2¢	\$50	\$100	\$25.00	\$12.5
50¢	10¢	\$100	\$50	\$37.50	\$ 7.5
50¢	20¢	\$120	\$90	\$84.64	\$21.7
90¢	60¢	\$100	\$200	\$19.00	\$ 1.9
80¢	80¢	\$180	\$150	\$17.00	\$51.0

2. Name at sight the loss per cent :

<i>Cost</i>	<i>Loss</i>	<i>Cost</i>	<i>Loss</i>	<i>Cost</i>	<i>Loss</i>
5¢	1¢	\$1	1¢	\$1.50	\$0.50
8¢	1¢	\$1	20¢	\$1.25	\$0.25
8¢	3¢	\$1	5¢	\$0.75	\$0.25
0¢	2¢	\$5	\$1	\$3.20	\$0.80
0¢	4¢	\$5	\$2	\$1.60	\$0.20
2¢	3¢	\$10	\$1.50	\$4.50	\$0.90
0¢	1¢	\$10	\$2.20	\$3.60	\$0.60
0¢	2¢	\$10	\$1.25	\$5.40	\$0.90

Find the gain or loss per cent if :

3. The cost is \$8 and the selling price \$10 ; the selling price \$12.
4. The cost is \$2 and the selling price \$10 ; the selling price \$6.
5. The cost is \$8 and the selling price \$7 ; the selling price \$6.
6. The cost is \$12 and the selling price \$24 ; the selling price \$36.

Find the gain per cent if :

7. Cheese is bought at 24¢ a pound and sold at 40¢ a pound.
8. Oranges are bought at 40¢ a dozen and sold at 60¢ a dozen.
9. Potatoes are bought at \$1.60 a bushel and sold at \$0.60 a bushel.
10. Shoes are bought at \$6 a pair and sold at \$10 a pair.
11. Lemons are bought at 25¢ a dozen and sold at 3 for 10¢.

PROBLEMS IN PROFIT AND LOSS

1. Mr. Reed paid \$1.25 a bushel for potatoes and sold them at \$2.25 a bushel. What per cent profit did he make, if the overhead charges were \$0.25 ?

\$2.25 = the selling price

1.50 = the cost, which includes overhead charges

.75 = the net gain

\$0.75 = $\frac{1}{2}$ of \$1.50. Therefore, 50% = the rate of profit.

2. What per cent profit does a newsboy make on daily paper which he buys for \$1.25 per hundred and sells at 2¢ each?
3. What is the gain per cent on goods sold at 3 times their cost 2 times their cost? $1\frac{1}{2}$ times their cost? 1.75 times their cost?
4. If candy that cost 60¢ a pound was retailed at \$1 a pound what per cent of the cost was gained? What per cent of the selling price?
5. Walter found out that some silk shirts that cost \$4 each were being sold for \$7.50 each. What was the per cent of profit?
6. Mr. West paid \$6 for 12 doz. oranges, 3 doz. of which were unsalable; the remainder he sold at the rate of 3 for 20¢. His profit was what per cent of the price paid for the oranges? What per cent of the price received?
7. If a man whose full time work is 44 hr. a week is idle $1\frac{3}{8}$ days of 8 hr. each, what per cent of full time is he idle? What per cent of full time does he work?
8. A candy manufacturer told retailers that they should retail at \$1.20 candy for which they paid \$0.80; that this would allow them a profit of $33\frac{1}{3}\%$. Was the manufacturer reckoning the profit on the cost or on the selling price?

Commission. During the summer vacation Caroline took subscriptions for a farm journal. Her orders amounted to \$75. The publishers paid her for securing these subscriptions by allowing her to retain 20% of this amount. The money she earned in this way is called *commission*. What was Caroline's commission?

A person who transacts business for another is usually called an *agent*. The money paid an agent for services is called *commission*; it is a certain per cent of the money involved in the transaction. Who was the agent in the above illustration?

PROBLEMS IN COMMISSION

1. Arthur collected \$250 of outstanding bills for his father and was paid a commission of 1%. What was his commission?
2. Samuel took orders for a book which sold for \$3.50. During the summer he sold 85 books and was paid a commission of 30%. What commission did he earn?
3. Each Saturday Arthur takes orders for Victrola records. He is allowed a commission of 20% of his sales. If his orders for March were \$48, what was his commission?
4. Edith helps to pay her way through college by selling fine dresses during her vacations. In one year her sales amounted to \$160, and she was allowed a commission of $33\frac{1}{3}\%$. What was her commission?
5. Andrew takes orders for fruit trees and is allowed a commission of 50%. He sold Mr. Hamilton an order of 20 peach trees at \$1 each, 4 cherry trees at \$1.50 each, and 12 apple trees at \$1.25 each. What was his commission on this order?
6. During the summer vacation Emma takes orders for flavoring extracts. She is paid a commission of $33\frac{1}{3}\%$ on all sales. One month she sold 120 bottles at 35¢ each, 63 bottles at 50¢ each, and 27 bottles at \$1 each. What was her commission for that month?
7. Each autumn Eva takes orders for spring-flowering bulbs. She is allowed a commission of 50% on all sales. What was her commission on the following order?
4 hyacinth bulbs at 30¢ each
24 bulbs of early single tulips, at 12 for 90¢
8. A company paid Harold \$50 a month during July and August for selling photographic views, and a commission of 20% on all sales. His sales for July amounted to \$110 and for August \$124. How much did he earn in this way during July and August?

9. An agent sold a house for Ellen's father for \$7500. He charged a commission of 2%. What was his commission?

10. Walter's father sells produce on commission, charging 10% on all sales. Find his commission on his sales for one week, which were

610 lb. dressed spring chicken at 80¢ per pound

420 doz. eggs at 65¢ per dozen

125 lb. butter at 80¢ per pound

11. An agent charged Mr. Thompson \$60 for selling a building lot for which the purchaser paid \$3000. What rate of commission did the agent charge?

12. A real estate agent sold a tract of 80 acres of land at \$12 an acre. He charged a commission of 5% on the selling price. The transfer of the property cost \$30.25 additional. How much should be paid to the owner?

13. What commission does an agent receive for collecting the monthly rents for the owner of an apartment house, if this house contains four apartments which rent for \$50, \$45, \$45, and \$40, his commission being 5% of the rent?

14. If you know of any one who buys and sells goods on commission in your neighborhood, tell the class about it; also make and solve problems about the work which these persons do.

Interest. If your father hires an automobile or a boat or rents a house, he is using the property of another and must pay for the use of it. If he borrows money, this is using the property of another and he must pay for the use of it.

Money paid for the use of money is called *interest*.

The person who borrows money usually pays a certain per cent of the sum borrowed for the use of the sum each year.

Thus, if Mr. Wood borrows \$100 at 6%, he pays 6% of \$100, or \$6, for the use of the money borrowed for 1 year; he pays 2 times \$6 for its use for 2 years, or $2\frac{1}{2}$ times \$6 for its use $2\frac{1}{2}$ years.

FINDING INTEREST

1. What is one year's interest on \$100 at 5%?
2. What is one year's interest on \$100 at 6%? at 7%?
3. What is one year's interest on \$200 at 5%? at 6%?
4. At 4% what is the interest on \$100 for 6 months?
5. At 5% what is the interest on \$500 for 1 year? for 6 months?

What is the interest on:

- | | |
|---|--|
| 6. \$200 for 3 yr. at 6%? | 7. \$300 for 2 yr. at 5%? |
| 8. \$400 for 3 yr. at 7%? | 9. \$800 for 3 yr. at 4%? |
| 10. \$90 for 2 yr. at 5%? | 11. \$50 for 3 yr. at 6%? |
| 12. \$180 for 3 yr. at 7%? | 13. \$275 for 2 yr. at 5%? |
| 14. \$300 for 2 yr. at $4\frac{1}{2}\%$? | 15. \$650 for 10 yr. at $3\frac{1}{4}\%$? |

Remember that $4\frac{1}{2}\% = .045$ and that $3\frac{1}{4}\% = .0325$.

- | | |
|--|---|
| 16. \$500 for 5 yr. at $3\frac{3}{4}\%$? | 17. \$500 for 4 yr. at $3\frac{3}{4}\%$? |
| 18. \$300 for $2\frac{3}{4}$ yr. at 6%? | 19. \$200 for $2\frac{1}{4}$ yr. at 5%? |
| 20. \$200 for $3\frac{1}{2}$ yr. at 6%? | 21. \$600 for $3\frac{5}{12}$ yr. at 5%? |
| 22. \$500 for $2\frac{1}{2}$ yr. at $4\frac{1}{2}\%$? | 23. \$500 for 2 yr. at 4.8%? |

Interest for a Period of Less than a Year. Money is usually borrowed from banks, and for periods of less than a year. In finding time for which interest should be paid on a loan, bankers usually count the exact number of days for which the loan is made, if the time is less than a year.

Thus, if Mr. Evans should borrow money from a bank May 1 and pay it back August 29, the banker would charge him interest for 30 days in May, 31 in June, 31 in July, and 29 in August, or 120 days in all. Notice that May 1 is not counted but that August 29 is counted.

In computing interest for a period of time less than a year, it is the general custom to count 360 days for a year. In all problems of this kind find out and follow the method used by your bankers.

INTEREST FOR A PERIOD OF LESS THAN ONE YEAR

1. Find the interest on \$275 from June 1 to Nov. 16 at 6%.

\$275	The number of days from June 1 to Nov. 16	June
.06	is counted as here shown.	July
16.50	The time is 168 da., or $\frac{168}{360}$ yr., or $\frac{7}{15}$ yr.	Aug.
7		Sept.
15 $\overline{)115.50}$	$.06 \times \$275$, or \$16.50 = the interest for 1 yr.	Oct.
7.70	$\frac{7}{15} \times \$16.50$, or \$7.70 = the interest for 168 da.	Nov.

In your answers, disregard fractional parts of a cent less than 5 mills, and call 5 mills or more 1 cent.

Find the interest on :

2. \$200 for 60 da. at 6%.
3. \$240 for 30 da. at 6%.
4. \$300 for 90 da at 6%.
5. \$280 for 30 da. at 5%.
6. \$400 for 90 da. at 4%.
7. \$360 for 15 da. at 6%.
8. \$350 for 120 da. at 5%.
9. \$75 for 240 da. at 5%.
10. \$120 for 40 da. at 5%.
11. \$200 for 80 da. at 3%.
12. \$260 for 40 da. at 5%.
13. \$320 for 246 da. at $4\frac{1}{2}\%$.
14. \$240 from Sept. 1 to Dec. 15 at 6%; at $5\frac{1}{2}\%$.
15. \$360 from Apr. 1 to Aug. 9 at 5%; at 6%.
16. \$500 from March 15 to July 3 at $3\frac{1}{2}\%$; at $4\frac{1}{2}\%$.

Interest for a Period of More Than a Year. In computing interest for a time greater than a year, custom varies as to the method of computing the time between dates. For example, the time from June 21, 1922, to Sept. 16, 1924, may be counted thus :

2 years from June 21, 1922, to June 21, 1924, and 87 days from June 21, 1924, to Sept. 16, 1924, making in all 2 yr. 87 da., or

Again the time may be counted thus:

yr.	mo.	da.	September is the 9th month and June the 6th month of
1924	9	16	the year. Since 21 da. cannot be subtracted from 16 da.,
1922	6	21	1 mo. of the 9 mo. is changed to 30 da., which added to 16
2	2	25	da. gives 46 da. 46 da. - 21 da. = 25 da. 8 mo. - 6 mo. =
			2 mo. 1924 yr. - 1922 yr. = 2 yr. The time by this method
			counting is 2 yr. 85 da., since 1 mo. is called 30 da.

By the first method of counting, we see that the time as reckoned is $2\frac{87}{360}$ yr., and by the second $2\frac{85}{360}$ yr.

FINDING INTEREST FOR ONE YEAR OR MORE

In the first five problems of the following exercise count the time by the method used in your state. The answers are given by both methods.

- Find the interest on \$200 from Mar. 1, 1922, to May 15, 1924, at 6%.
- Find the interest on \$300 from Apr. 15, 1923, to July 20, 1925, at 5%.
- Find the interest on \$250 from May 20, 1924, to Sept. 17, 1925, at 4%.
- Find the interest on \$500 from June 15, 1925, to Nov. 12, 1926, at 6%.
- Find the interest on \$780 from Sept. 15, 1924, to Jan. 13, 1926, at 5%.
- What is the yearly interest at $3\frac{1}{2}\%$ on a \$500-bond of the first Liberty Loan?
- What is the yearly interest at 4% on a \$1000-bond of the second Liberty Loan?
- What is the yearly interest at $4\frac{1}{4}\%$ on a \$5000-bond of the third Liberty Loan?

PROMISSORY NOTES

If William Brown borrows a sum of money, as \$100, from Frank Field for 6 months at 6% interest, it is customary for him to give Frank Field a paper like the following, called a *promissory note*.

\$100 ⁰⁰	Wilmington Del, June 1 1921
six months	after date I promise to pay to
the order of Frank Field	
One Hundred	00 Dollars
Payable at The Union National Bank of Wilmington	
Value received, with interest at 6%	
Number 57	Due Dec 1 1921
William Brown	

In this promissory note William Brown is called the **maker** of the note and Frank Field the **payee**. One hundred dollars is called the **face** of the note.

1. A promissory note should state the time and place at which it was given. Read the date of the above promissory note, and state where it was given.
2. If a note is to be paid a certain number of months after date, calendar months are to be counted. On what date should William Brown pay the above note? Where is he expected to pay it?
3. How much interest will William Brown have to pay on the above note?
4. When is a note due that is dated March 1 and is payable in 2 months? in 6 months? in 9 months?
5. When is a note due that is payable 60 days after July 1?

SUGGESTION. In counting forward 60 days, do not count July 1; count 30 days for July.

6. When is a note due that is dated April 1 and is payable in 90 days? in 90 days?

7. Who is expected to pay the note, page 240, when it is due? How much will he pay? Who will receive the note when it is paid?

8. Write a promissory note for \$20 with yourself as maker and one of your classmates (naming him) as payee. Date the note properly and make it payable at your home bank in 90 days. Find how much you should pay when the note is due, if the note earns interest at 6%.

9. Find the interest due on a promissory note for \$250 dated June 1, and paid December 15, interest 6%.

SUGGESTION. Count the number of days from June 1 to December 15, including June 1.

10. When is a note due that is dated December 31, 1920, payable in 2 months?

11. Write a promissory note for \$10 with yourself as maker, and David Fiske as payee. Date the note June 1 of last year and make it payable in 90 days.

12. Suppose you buy a bicycle from one of your classmates for \$37.50 payable in 6 months. Write the promissory note that you would give him in payment.

13. Write a promissory note dated at your place of residence February 15 of last year and payable in 9 months at a national bank near your home, with interest at 6%. Make one of your classmates (naming him) the payee of the note and yourself the maker. Find when the note is due and how much is due. Who should pay the note when it is due? Who should receive the note when it is paid?

CHECKS

A person who transacts much business usually *deposits* money in a bank and when he wishes to draw out any or all of this money or to pay a debt, he uses a paper like the following, called a *check*, by which the bank is directed to pay out money belonging to him.

THE FIRST NATIONAL BANK OF BOSTON 5-39	
BOSTON, MASSACHUSETTS, <u>Sept. 6</u> 19 <u>21</u>	
PAY TO THE ORDER OF <u>George P. Thompson</u>	<u>\$28²⁵/₁₀₀</u>
<u>Twenty-eight²⁵/₁₀₀</u> DOLLARS	
No. <u>274</u>	<u>Norman C. Cameron</u>

Before the holder of a check can have it cashed, he must write his name across the back of it. This is called *indorsing* the check.

1. Which of the men are shown by the above check have

money deposited in the First National Bank of Boston?

2. Suppose you have money deposited in a bank, write the check with which you could pay one of your classmates (naming him or her) a debt of \$5.

3. Have your classmate indorse the check of example 2, and supposing the bank would cash the check, tell what the owner of the check would do to get the money.

4. If you wish to draw out \$5 of the money you have deposited in the bank, you would write *Cash*, *Myself*, or *Self* where the

George P. Thompson

name *George P. Thompson* is written in the above check and sign your name where the name *Norman C. Cameron* appears. Write the check which you would use.

5. Get a blank form of check at your home bank and show the class how to fill it out.

RECEIPTS

When a person pays a debt in part or in full he is usually given a paper called a *receipt*, which is an acknowledgment that such payment has been made. Here is the receipt which James Gordon has given when he paid Samuel Bennett a debt of \$25.

<i>Kansas City, Mo., July 1, 1921</i>	
<i>Received from James Gordon</i>	
<i>Twenty-five</i>	<i>00/100</i> <i>Dollars</i>
<i>in full of all accounts to date</i>	
<i>\$25.00</i>	<i>Samuel Bennett</i>

NOTE. When the money paid is only part of the debt owed, *on account* could be written in the receipt instead of *in full of all accounts to date*.

1. Write a receipt showing that one of your classmates (naming him or her) has paid you \$5 in full of all accounts to date.
2. Write a receipt showing that one of your classmates (naming him or her) has paid you \$2.50 on account.
3. Write a receipt for \$2.75 paid you on July 31 last for work done for a man (naming him) in your neighborhood.
4. Write a receipt for \$42 paid in full September 2 last, for carpenter work done by John Miller for Russell Ambler.

CHAPTER V

MEASURES

If this exercise requires the use of any fact with which you are not familiar, refer to the tables on page 280.

REVIEW AND USE OF TABLES

1. Write the table of liquid measure, using proper abbreviations.
2. How many cubic inches are there in a 5-gallon pail?
3. How many pints are there in a gallon?
4. Write the table of dry measure, using proper abbreviations.
5. A cubic foot is about .8 of a bushel. How many bushels will a box hold if it contains 30 cu. ft.?
6. Using facts given in the table of dry measure, find how many quarts there are in a bushel.
7. How many pint packages of seed can be made from a bushel of seed?
8. Make a list of five articles which are sold by the bushel in your neighborhood and find out how many pounds a dealer must give for a bushel of each.
9. What is the cost of 2 lb. 12 oz. of sirloin steak at 40¢ a pound?
10. How many pounds are there in a hundredweight? What use is made of the hundredweight?
11. What is the cost of 3000 lb. of coal at \$14 a ton?

12. What is the weight of a barrel of flour?
13. Name ways in which flour is sold other than by the barrel. Give prices.
14. Name in order the months of the year, and as you do so state the number of days in each.
15. The day begins at midnight. What is the 4th hour of the day? the 12th? the 15th?

REVIEW AND USE OF TABLES

1. Any year whose number is divisible by four, except a year ending in two zeros, is a *leap year*. Is this year a leap year? Was last year a leap year? Will next year be a leap year? Name four leap years.
2. How many hours are there from 6 P.M. to 6 A.M. the next day?
3. How is the 8th hour after noon written? the 8th after midnight? 2 hours and 15 minutes after midnight?
4. What does 12.02 A.M. mean? 12.02 P.M.? 12 M.?
5. A year whose number ends in 2 zeros and which is divisible by 400 is a leap year. Write two such years that were leap years.
6. Write the table of length, using proper abbreviations.
7. Using facts given in the table of length, find how many yards there are in a mile; also how many feet in a mile.
8. A unit of length called a *fathom* (6 ft.) is used to measure the depth of the ocean. How many feet deep is the ocean at a place where it is 2000 fathoms deep? 5000 fathoms?
9. A unit of length called a *hand* (4 in.) is used in measuring the height of a horse. Find out how the height of a horse is measured.

10. How many feet high is a horse which is 15 hands high?
 $14\frac{1}{2}$ hands?

11. The speed of a vessel is usually expressed in *knots per hour* (1 *knot* = 6080.27 ft.). Find the number of miles in a knot, correct to the nearest .01.

12. Write the table of square measure, using proper abbreviations.

13. Using facts given in the table of square measure, find out how many square yards there are in an acre; also how many square feet.

14. Write the table of cubic measure, using proper abbreviations.

15. 1 A. = ... sq. rd. = ... sq. yd. = ... sq. ft.

REVIEW AND USE OF TABLES

1. When potatoes are quoted at \$3 per 100 pounds, how much is that per pound? How much is that per bushel (60 lb.)?

2. When bran is selling at \$40 a ton, how much is that a pound? a hundredweight?

3. Read the following, supplying the missing numbers:

1 gal. = ... qt.	1 cu. ft.	= ... cu. in.
1 pk. = ... qt.	1 sq. yd.	= ... sq. ft.
1 bu. = ... pk.	1 acre	= ... sq. rd.
1 ft. = ... in.	1 cu. yd.	= ... cu. ft.
1 qt. = ... pt.	1 sq. ft.	= ... sq. in.
1 yd. = ... ft.	1 short ton	= ... lb.
1 da. = ... hr.	1 sq. rd.	= ... sq. yd.
1 rd. = ... yd.	1 min.	= ... sec.
1 hr. = ... min.	1 lb.	= ... oz.
1 wk. = ... da.	1 common year	= ... da.

4. One *geographic mile* is equal to 6080.27 ft. One *league* is geographic miles. How many feet are there in a league?
5. The number of feet in a league is . . . (see answer to example 4). Find the number of miles in a league, correct to the nearest .01.
6. If a weight is expressed in pounds, what must you do to express it in hundredweight? in tons? in ounces?
7. Review example 6, page 121.
8. Find the cost of 3600 lb. of hay at \$28 per ton.

SUGGESTION. 3600 lb. = 1.8 T. (Divide 3600 by 1000 and the quotient 2.)

Find the cost of:

9. 2440 lb. of straw at \$12 per ton; at \$1.25 per hundredweight.
10. 1850 lb. of hay at \$30 per ton; at \$2.75 per hundredweight.
11. 275 lb. of bran at \$28 per ton; at \$1.50 per hundredweight.
12. 4675 lb. of coal at \$12.75 per ton.

Compound Amounts. Expressions like 3 ft. 6 in., 2 gal. 3 qt., and 4 hr. 30 min. 12 sec. are called *compound amounts*.

REDUCTION

1. Reduce 8 rd. 2 yd. to yards.

EXPLANATION

The answer may be found thus:

$$1 \text{ rd.} = 5\frac{1}{2} \text{ yd.}$$

$$8 \text{ rd.} = 8 \times 5\frac{1}{2} \text{ yd., or } 44 \text{ yd.}$$

$$8 \text{ rd. } 2 \text{ yd.} = 44 \text{ yd.} + 2 \text{ yd., or } 46 \text{ yd.}$$

$$\begin{array}{r} 8-2 \\ \underline{5\frac{1}{2}} \\ 44 \\ \underline{2} \\ 46 \end{array}$$

2. Reduce 50 pk. to bushels and pecks.

EXPLANATION

The number of pecks $\div 4$ = the number of bushels.
Therefore 50 pk. = 12 bu. 2 pk.

The answer may be found thus :

4)50

12 and 2 over

Reduce :

3. 7 lb. 2 oz. to ounces ; to pounds.
4. 4 T. 8 cwt. to hundredweight ; to tons.
5. 4 da. 9 hr. to hours ; to days.
6. 3 A. 20 sq. rd. to square rods ; to acres.
7. 12 gal. 3 qt. to quarts ; to gallons.
8. 2 mi. 20 rd. to rods ; to miles.
9. 8 bu. 3 pk. to pecks ; to bushels.
10. 12 rd. 3 yd. to yards ; to rods.
11. 93 pk. to bushels and pecks ; to quarts.
12. 121 qt. to gallons and quarts ; to gallons.
13. 1000 oz. to pounds and ounces ; to pounds.
14. 450 min. to hours and minutes ; to seconds.
15. 4675 lb. to tons and pounds ; to hundredweight.
16. 68 yd. to rods and yards ; to feet.
17. 400 in. to feet and inches.

ADDITION AND SUBTRACTION

1. Find the sum of 28 yr. 8 mo. 18 da. and 14 yr. 7 mo. 15 da.

yr.	mo.	da.	
28	8	18	The sum of the days is 33 da., or 1 mo. 3 da. (count 1 mo. = 30 da.). Write 3 under the days and add 1 mo. to months.
14	7	15	The sum of the months is 16 mo., or 1 yr. 4 mo. Write
43	4	3	under the months and add 1 yr. to years. The sum of the years is 43 yr. The sum is 43 yr. 4 mo. 3 da.

2. From 24 yr. 9 mo. 26 da. take 16 yr. 11 mo. 15 da.

<i>mo.</i>	<i>da.</i>	15 da. from 26 da. leaves 11 da. Write 11 under the days.
9	26	We cannot take 11 mo. from 9 mo., so we take 1 yr., or 12 mo.,
11	15	from 24 yr. (leaving 23 yr.) and add it to 9 mo., making 21 mo.;
10	11	11 mo. from 21 mo. leaves 10 mo. 16 yr. from 23 yr.
		leaves 7 yr. The difference is 7 yr. 10 mo. 11 da.

3. Theodore Roosevelt was born Oct. 27, 1858, and died Oct. 6, 1919; to what age did he live?

<i>yr.</i>	<i>mo.</i>	<i>da.</i>	He was born on the 27th day of the 10th month of the
19	1	6	year 1858, and died on the 6th day of the 1st month of the
58	10	27	year 1919. The difference, or 60 yr. 2 mo. 9 da., was the
60	2	9	age to which he lived,

Add; check:

<i>ft.</i>	<i>in.</i>	<i>5. ft.</i>	<i>in.</i>	<i>6. A.</i>	<i>sq. rd.</i>	<i>7. A.</i>	<i>sq. rd.</i>
3	6	9	8	4	120	8	90
4	9	10	6	9	100	7	140
8	7	8	11	2	40	2	80

<i>hr.</i>	<i>min.</i>	<i>sec.</i>	<i>9. yr.</i>	<i>mo.</i>	<i>da.</i>	<i>10. yr.</i>	<i>mo.</i>	<i>da.</i>
8	25	42	9	8	24	1922	6	18
9	14	28	11	9	20	49	8	14

Subtract:

<i>ft.</i>	<i>in.</i>	<i>12. ft.</i>	<i>in.</i>	<i>13. T.</i>	<i>cwt.</i>	<i>14. A.</i>	<i>sq. rd.</i>
8	2	121	9	8	12	42	20
6	8	18	10	2	15	14	110

<i>hr.</i>	<i>min.</i>	<i>sec.</i>	<i>16. da.</i>	<i>hr.</i>	<i>min.</i>	<i>17. yr.</i>	<i>mo.</i>	<i>da.</i>
9	8	12	6	8	15	1930	8	2
2	50	40	2	12	20	1864	11	9

PROBLEMS IN ADDITION AND SUBTRACTION

1. Daniel Webster was born Jan. 18, 1782, and lived to the age of 70 yr. 9 mo. 6 da. On what date did he die?
2. George Washington was born Feb. 22, 1732, and died Dec. 14, 1799. To what age did he live?
3. If a piece 8 ft. 10 in. long is cut from a board 16 ft. long what is the length of the piece of board that remains?
4. A cart loaded with coal weighed 1 T. 865 lb. The cart weighed 968 lb. Find the weight of the coal.
5. Find out when Abraham Lincoln was born, when he died and to what age he lived.
6. Find out when Henry W. Longfellow was born, when he died, and to what age he lived.
7. In Michigan the sun rose on Oct. 1 at 5.57 A.M. and set at 5.42 P.M. How long was it from sunrise to sunset in Michigan that day?
8. Find out at what time the sun will rise to-morrow where you live and at what time it will set, and the time from sunrise to sunset.
9. A carpenter cut from a 16-ft. board three pieces, the first 2 ft. 6 in. long, the second 6 ft. 9 in., and the third 4 ft. 10 in. What was the length of the piece remaining?
10. If a partial eclipse of the sun began at Springfield, Ill., at 7.59 A.M. on a certain day and ended at 9.32 A.M., what was the duration of the eclipse at that place?
11. A train leaves New York each day at 2.55 P.M. and is scheduled to reach Chicago in 20 hr. At what hour the next day should it reach Chicago?

12. A train leaves Chicago at 12.40 P.M. and is scheduled to reach New York in 20 hr. At what hour the next day should it reach New York?

13. How long does it require a train to run from New York to Richmond, Va., if the train leaves New York at 12.15 A.M. and arrives at Richmond at 12.30 P.M.?

14. A train which is scheduled to leave New York at 2.55 P.M. and arrive at Pittsburgh at 12.30 A.M. the next day requires how many hours to make the run, provided that it reaches Pittsburgh on time?

15. Bring to school a local time-table and read from it times at which trains leave your station and times at which they arrive at other stations marked on the same time-table.

MULTIPLICATION AND DIVISION

1. Multiply 2 bu. 3 pk. by 9.

<i>bu.</i>	<i>pk.</i>	
2	3	
9		
24	3	

$9 \times 3 \text{ pk.} = 27 \text{ pk., or 6 bu. 3 pk.}$
 $9 \times 2 \text{ bu.} = 18 \text{ bu.}$
 $18 \text{ bu.} + 6 \text{ bu.} = 24 \text{ bu.}$
 The product is 24 bu. 3 pk.

2. Divide 13 ft. 8 in. by 4.

<i>ft.</i>	<i>in.</i>	
13	8	
3	5	

$13 \text{ ft.} \div 4 = 3 \text{ ft., and 1 ft. over.}$
 $1 \text{ ft. 8 in.} = 20 \text{ in.}$
 $20 \text{ in.} \div 4 = 5 \text{ in.}$
 The quotient is 3 ft. 5 in.

Multiply :

- | | |
|--------------------------------|------------------------------|
| 3. 3 ft. 6 in. by 5. | 4. 5 gal. 3 qt. by 6. |
| 5. 2 bu. 2 pk. by 8. | 6. 8 ft. 4 in. by 9. |
| 7. 3 A. 120 sq. rd. by 5. | 8. 2 T. 875 lb. by 6. |
| 9. 2 hr. 40 min. 15 sec. by 6. | 10. 2 yr. 6 mo. 18 da. by 8. |

Divide and check :

11. 19 gal. 2 qt. by 6. 12. 41 ft. 8 in. by 5.
 13. 6 A. 40 sq. rd. by 4. 14. 29 bu. 1 pk. by 9.
 15. 51 wk. 3 da. by 6. 16. 12 A. 120 sq. rd. by 5.
 17. 25 hr. 37 min. 52 sec. by 8. 18. 29 yr. 9 mo. 10 da. by 8.
 19. At \$0.50 an hour, how much will Andrew earn from 7.30 A.M. till noon and from 1 P.M. till 4.30 P.M.?
 20. Mr. Lewis bought 2 A. 120 sq. rd. of land and divided it into 8 building lots of equal size. Find the number of square rods in each lot.

ANGLES AND PARALLEL LINES

1. Which of these pairs of lines form *right angles*; that is, angles like those at the corners of a leaf of this book?



2. Which pair of lines forms an *acute angle*; that is, an angle less than a right angle?

3. Which pair of lines forms an *obtuse angle*; that is, an angle greater than a right angle?

4. When one line makes a right angle with another line, each line is said to be *perpendicular* to the other. Which of the pairs of lines above are perpendicular to each other?

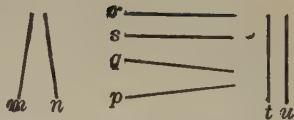
5. Point out four pairs of lines in the room which are perpendicular to each other.

6. Cut from a sheet of paper a piece having four angles, two acute and two obtuse.

7. Cut from a sheet of paper a piece having four angles, one right, one obtuse, and two acute.

8. Point out the right angles on a sheet of paper; on a card; on an envelope.

9. Which of these pairs of lines are *parallel*; that is, are everywhere the same distance apart like the shorter edges of this leaf of your book?



10. Point out lines on a rule that are parallel; lines in this room.

11. Cut out from a sheet of paper a piece which has two edges either perpendicular nor parallel.

12. Bring to class a sheet of paper on which you have drawn exactly a right angle, an acute angle, an obtuse angle, a pair of parallel lines, a pair of lines perpendicular to each other, and a pair neither perpendicular to each other nor parallel.

13. Draw on the blackboard a pair of lines which are parallel; a pair which are perpendicular to each other.

Surface. What you see of the ceiling of the room has *length* and *breadth*, but not thickness. Anything which has length and breadth but not thickness is called *surface*. Name four surfaces.

Plane Surface. A *level surface* like the surface of a table, or a floor, is called a *plane surface*. Name four plane surfaces.

THE SQUARE

1. A square is a plane surface which is bounded by how many straight lines? How many pairs of parallel lines?

2. How do the sides of a square compare in length? Test.

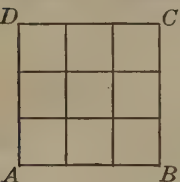
3. If one side of a square is 2 yd. long, what is the sum of the four sides (*the perimeter*) of the square?

4. What is the perimeter of a square whose side is 10 ft. long?

5. If the perimeter of a square is 80 yd., what is the length of one side?

6. What kind of angles are the angles of a square?

7. If square $ABCD$ were 3 in. long, how many square inches would it contain? If it were 3 ft. long, how many square feet would it contain? If it were 3 yd. long, how many square yards would it contain?



The number of square units in a square (that is, its size, or area) is the square of the number of units in its length.

Thus, 3^2 , or 9 = the number of square units in square $ABCD$.

8. How many square inches are there in a 10-in. square; that is, a square 10 in. long?

9. How many square inches are there in a 12-in. square? a 1.5-in. square? a 2.5-in. square? a 4.6-in. square?

10. What is the perimeter in feet of a square 40 yd. long?

11. The number of square feet in a square lot 60 ft. long may be indicated thus: 60×60 , and the number of square yards found

thus: $\frac{60 \times 60}{9}$. To shorten the required division, cancel. How

many square yards are there in this lot?

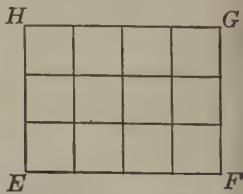
12. How many acres are there in a square lot 80 rd. long? (Indicate the work and cancel.)

THE RECTANGLE

1. A rectangle is a plane figure which is bounded by how many straight lines? How many pairs of parallel lines?

2. How many and what kind of angles has a rectangle?

3. In a rectangle the parallel sides are called *opposite sides*. Measure the opposite sides of rectangle $EFGH$ and tell how they compare in length.



4. If one side of a rectangle is 6 ft. and another side is 4 ft., what is the sum of the four sides (the perimeter) of the rectangle? Remember that *the opposite sides of a rectangle are equal*.

5. What is the perimeter of Edward's garden, which is in the form of a rectangle 36 ft. long and 24 ft. wide?

6. If rectangle $EFGH$ were 4 in. long and 3 in. wide, how many square inches would it contain? If it were 4 ft. long and 3 ft. wide, how many square feet would it contain? If it were 4 yd. long and 3 yd. wide, how many square yards would it contain?

The number of square units in a rectangle (that is, its size, or area) is equal to the product of the number of units in the length and the number of units in the width.

Thus, 4×3 , or 12, = the number of square units in $EFGH$.

7. How many square feet of surface are there in a floor 20 ft. long and 18 ft. wide?

8. How many square yards are there in the ceiling of a room 24 ft. long and 21 ft. wide? Indicate the work and cancel.

9. How many square yards are there in a lot 150 ft. long and 10 ft. wide? Indicate the work and cancel.

10. How many square yards of bunting are there in a piece 24 ft. long and $1\frac{1}{2}$ yd. wide?

SUGGESTION. Reduce 24 ft. to yards.

11. How many acres are there in a field 40 rd. long and 20 rd. wide? Indicate the work and cancel.

12. How many acres are there in a lot 20 rd. long and 8 rd. wide?

13. How many square feet are there in an acre? What part of an acre does a lot contain that is 150 ft. long and 121 ft. wide?

14. If the floor of your classroom is a rectangle, find how many square feet it contains.

Dimensions of a Rectangle: The length and the width of a rectangle are called the dimensions of the rectangle.

GIVEN THE AREA AND ONE DIMENSION OF A RECTANGLE TO FIND THE OTHER DIMENSION

1. How many square inches in a rectangle 4 in. long and 3 in. wide? If you knew the number of square inches in a rectangle to be 12 and the number of inches in the width of the rectangle to be 3, how would you find the number of inches in the length?

To find one dimension of a rectangle when the other dimension and the area are given, divide the area by the number of units in the dimension given.

Thus, if the area, 12, and the number of units, 4, in one dimension of the rectangle on page 254 are given, the number of units in the other dimension is $12 \div 4$, or 3.

Find the length of:

2. A sheet of paper 5 in. wide containing 40 sq. in.; 35 sq. in.
3. A blotter 20 in. wide containing 500 sq. in.
4. A walk 4 ft. wide containing 160 sq. ft.
5. A garden 10 ft. wide containing 100 sq. ft.
6. A floor 12 ft. wide containing 240 sq. ft.

Find the width of:

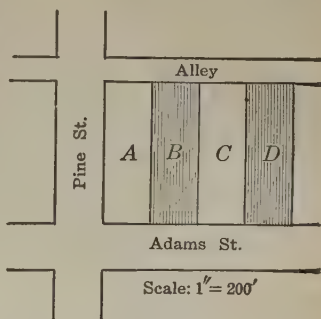
7. A piece of linoleum 10 yd. long containing 20 sq. yd.
8. A piece of wall paper 24 ft. long containing 36 sq. ft.
9. A garden 20 ft. long containing 200 sq. ft.
10. Mr. Mills bought a lot containing 4000 sq. ft.; one of its dimensions is 40 ft. What is the other?
11. Jordan's father wishes to mark off in one of his fields a rectangular lot 121 yd. long, which shall contain a half acre. How wide must he make the lot? (1 A. = 4840 sq. yd.)

PROBLEMS ABOUT BUILDING LOTS

Building lots are usually sold by the *front foot* (per foot). Thus, a lot extends 50 ft. along Adams Street, it is said to have a frontage of 50 ft. on that street, and if it is sold at \$40 per front foot (per foot), the selling price is $50 \times \$40$, or \$2000.

NOTE. By the depth of a lot is meant the distance it extends back from the street along which its frontage is measured.

1. The scale used in the figure is $1'' = 200'$. Tell what this means.
2. Rectangles A , B , C , and D represent lots fronting on Adams Street. How many feet frontage as each lot on this street?
3. How many feet deep is each of the lots shown here?
4. What is the value of lot A at \$50 per front foot?
5. How wide is Adams Street? Pine Street? the alley?
6. How many square feet are there in lot B ? in each of the other lots?
7. If Mr. Sampson pays \$40 per front foot for lot B , what price is he paying per square foot for it?
8. If Mr. Sampson builds a house 36 ft. long and 30 ft. wide on lot B , uses 200 sq. ft. of the rear of the lot as a garden, and the remainder of the lot as a lawn, how many square feet are there in the lawn?
9. Lot A is surrounded by a privet hedge which cost 20¢ a foot. What was the cost of the hedge?
10. Find out how building lots are sold in your neighborhood, and the prices in the different sections of it.

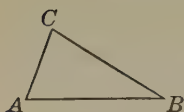


1. How long is the garden which is represented by this plan?
How wide?
2. To what scale is the garden plan drawn?
3. What is the perimeter of the garden?

X	Radish	2'	●	Carrots	3'
O	Cabbage	1'	Y	Tomatoes	1½'
Λ	Lettuce	4'	✱	Parsnips	3'
V	Onions	2'	↓	Salsify	3'
■	Beets	2'	T	Peppers	1'
	⌒	Egg-plants			1'

7. Onions are planted 2" apart and 2" from the border. How many onions should the two rows in this garden produce?
8. If 2 onions make a serving for one person, the onions from these 2 rows will be sufficient for how many meals for a family of five?
9. Cabbages are planted 1' apart and 1' from each border. The cabbages in this garden will last a family of five how many weeks, if they use one head of cabbage a week?
10. The key given below the garden plan shows how far the beets are planted apart in a row. How many beets will the two rows produce, the end plants being two inches from the ends of the row?
11. If the family uses from this home garden 8 beets at a meal and the remainder are sold in bunches of 6 each at 15¢ a bunch, how much is received from the beets sold?
12. From the key find how far tomatoes are planted apart in a row. The end plants are 6" from the ends of the row. If one plant produces $\frac{1}{2}$ pk. of tomatoes and the family uses 3 pecks of them, how much is received for the remainder, at 15¢ a half peck?
13. How many heads of lettuce will the two rows produce, the end plants being 4" from the ends of the row?
14. Parsnips, carrots, and salsify are planted how far apart in a row? The end plants are 3" from the ends of the row. If each kind of these vegetables are used each time that vegetable soup is served to the family, for how many meals will this garden provide sufficient of these vegetables for vegetable soup?
15. Each member of the family of five is served with 2 radishes at a meal, and the remainder of the 2 rows are sold in bunches of 4 each at 5¢ a bunch. How much is received for those sold?
16. How many peppers and how many egg-plants are set out in this garden, if each end plant is 6" from the end of the row?

PLANE SURFACES BOUNDED BY STRAIGHT LINES



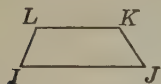
Triangle. A plane surface bounded by three straight lines is called a *triangle*; as, ABC .



Quadrilateral. A plane surface bounded by four straight lines is called a *quadrilateral*; as, $ABCD$.



Parallelogram. A quadrilateral whose opposite sides are parallel is called a *parallelogram*; as, $EFGH$.



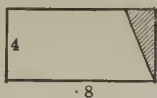
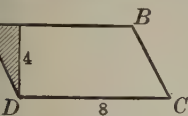
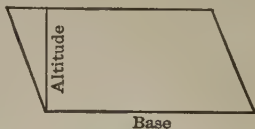
Trapezoid. A quadrilateral which has only one pair of sides parallel is called a *trapezoid*; as, $IJKL$.

1. Draw three triangles of different shapes.
2. Draw four quadrilaterals, two of which are parallelograms and two trapezoids.
3. Is a rectangle a parallelogram? Give a reason for your answer.
4. Is a square a parallelogram? Give a reason for your answer.
5. Cut from cardboard and bring to class four parallelograms, one of which is a rectangle and one a square.
6. Cut from cardboard and bring to class four quadrilaterals, one of which is a parallelogram; one a trapezoid, one neither a parallelogram nor a trapezoid, and one a rectangle.
7. Cut from cardboard and bring to class four trapezoids of different shapes.
8. Cut from cardboard and bring to class two triangles, one having a right angle, and one having an obtuse angle. What kind of angle is each of the other angles of these two triangles?

THE PARALLELOGRAM

Base and Altitude. The side of a parallelogram on which it is supposed to stand is called the *base*, and the perpendicular drawn from the side opposite the base to the base is called the *altitude*.

Area of a Parallelogram. $ABCD$ is a parallelogram whose base is 8 units and altitude 4 units. $ABCD$ may be changed



as shown in the figure to the right of it, into a rectangle 8 units long and 4 units wide. The area of the rectangle is

32. Therefore the area of $ABCD$ is 4×8 .

The area of a parallelogram is equal to the product of the number of units in the base and the number of units in the altitude.

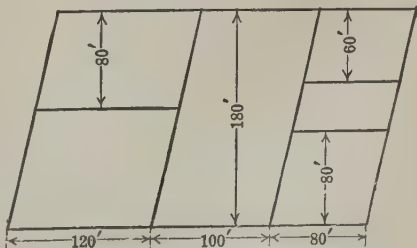
1. Measure the opposite sides of a parallelogram. How do they compare in length?

2. One side of a parallelogram is 8 ft. How long is the opposite side?

3. One side of a parallelogram is 10 ft., and another side is 6

ft. What is the sum of the sides (the perimeter) of the parallelogram?

4. The perimeter of a parallelogram is 32 ft. If one side of it is 12 ft., what is the length of each of the other sides?



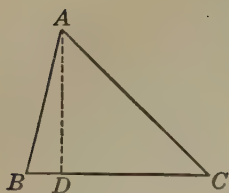
5. Each lot represented in the map is a parallelogram. Find the area of each.

To what scale is this map drawn?

Find the area of each of these parallelograms:

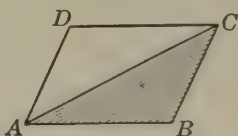
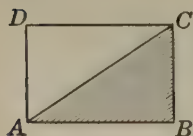
	7.	8.	9.	10.	11.	12.
Base :	10 yd.	8 rd.	.75 mi.	5.5 rd.	8.75 rd.	4.8 m.
Altitude :	2.5 yd.	$4\frac{1}{2}$ rd.	.08 mi.	5.5 rd.	1.8 rd.	2.25 m.

THE TRIANGLE



Base and Altitude. If we take BC as the base of triangle ABC , the perpendicular AD drawn to BC from A is the *height* or *altitude* of the triangle.

1. Cut from cardboard parallelograms like the three here shown. Cut each parallelogram along the line AC , and show that the shaded triangle in each parallelogram is one half of that parallelogram.



2. What is the base of the triangle CAB ? What is the base of the parallelogram $ABCD$?

3. How does the altitude of triangle CAB compare with the altitude of $ABCD$ in each figure?

4. What is the area of the parallelogram $ABCD$, if its base is 6 and its altitude 3? What is the area of the triangle ABC ?

The area of a triangle is equal to one half the product of the number of units in the base and the number of units in the altitude.

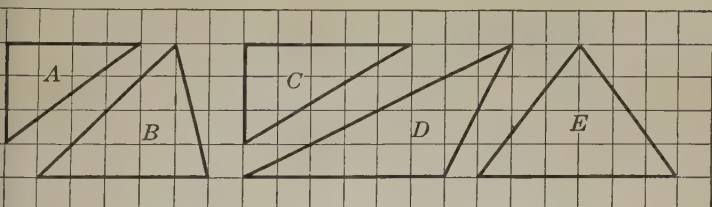
5. If the sides of a triangle are 13 ft., 14 ft., and 15 ft., what is the sum of the sides (the perimeter) of the triangle?

. The perimeter of a triangle is 30 ft.; if one of its sides is 10 ft. and another 6 ft., what is the third side?

Find the areas of triangles having bases and altitudes as follows:

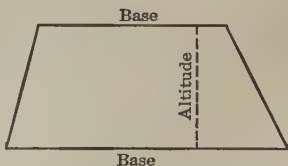
	7.	8.	9.	10.	11.	12.
Base:	10 ft.	5.5 yd.	20 rd.	6.5 rd.	8.75 rd.	.25 mi.
Altitude:	6 ft.	4 yd.	7.5 rd.	4.8 rd.	6.5 rd.	.5 mi.

3. Find the area of each of these triangles, counting the side of each small square as 1 rd. and the area of each small square as 1 sq. rd.:

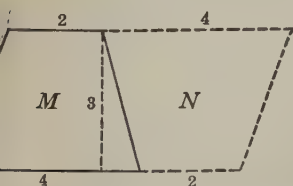


THE TRAPEZOID

Bases and Altitude. The parallel sides of a trapezoid are called its bases. The distance between the bases is called the *altitude*.



Cut from cardboard two trapezoids M and N of exactly the same size and place them as shown in the figure below. This figure is a parallelogram.



2. What is the altitude of trapezoid M ? of the parallelogram?

3. The sum of what two lines of trapezoid M is equal to the base of the parallelogram?

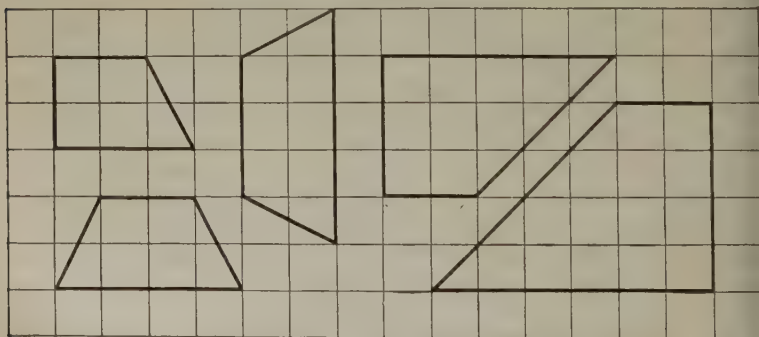
4. 3 times the sum of what two

of trapezoid M is equal to the area of the parallelogram?

5. What is the area of the parallelogram?
6. Trapezoid M is what part of the parallelogram?
7. What is the area of trapezoid M ?

The area of a trapezoid is equal to one half the product of the number of units in the altitude and the number of units in the sum of the bases.

8. What is the area of a trapezoid, the bases of which are 20 ft. and 8 ft., and the altitude 6 ft.?
9. Find the area of each of these trapezoids, counting each $\frac{1}{4}$ in. as 1 rod and each small square as 1 sq. rd.:



CARPETING

1. The number of yards of carpet $\frac{3}{4}$ yd. wide that must be bought to carpet a room 24 ft. long and 21 ft. wide with strip laid lengthwise may be found as follows:

21 ft. = the width of the floor.

$\frac{3}{4}$ yd., or $2\frac{1}{4}$ ft. = the width of a strip of carpet.

$21 \div 2\frac{1}{4}$, or $9\frac{3}{4}$ = the number of strips needed.

Then 10 strips must be bought, as strips are not cut lengthwise.

24 ft. or 8 yd. = the length of each strip.

10×8 , or 80 = the number of yards that must be bought.

NOTE 1. Carpets are usually either 1 yard or $\frac{3}{4}$ of a yard wide. The better grades, as velvet, Wilton, and Axminster, are $\frac{3}{4}$ of a yard wide. Linoleum and oilcloth are usually sold by the square yard.

NOTE 2. For sanitary reasons and for convenience, the use of rugs is rapidly replacing full carpets on floors which can be finished to good effect.

2. How many strips of carpet 1 yd. wide must be bought to carpet a room 18 ft. wide, the strips to be laid lengthwise?

3. How many strips of carpet $\frac{3}{4}$ yd. wide must be bought to carpet a room 15 ft. wide, the strips to be laid lengthwise?

4. How many strips of carpet $\frac{3}{4}$ yd. wide must be bought to carpet a room 16 ft. wide, the strips to be laid lengthwise?

5. How many yards of carpet 1 yd. wide must be bought to carpet a room 18 ft. long and 15 ft. wide?

6. How many yards of carpet $\frac{3}{4}$ yd. wide must be bought to carpet a room 24 ft. long and 18 ft. wide, the strips to be laid lengthwise?

7. Find the cost of carpeting a floor 24 ft. long and 21 ft. wide with carpet $\frac{3}{4}$ yd. wide at \$1.60 a yard, the strips to be laid lengthwise.

8. Make a drawing of a floor 21 ft. long and 18 ft. wide, scale = 4', showing strips of carpet 1 yard wide running lengthwise on the floor. Find the cost of the carpet at \$1.50 a yard.

9. Find the cost of linoleum required to cover the floor of a room 9 ft. long and 6 ft. wide, at \$1.20 a square yard.

10. At 80¢ a square yard, find the cost of the oilcloth for a room 15 ft. square.

11. A rug 9 ft. square is placed in the center of a floor 12 ft. square. How many square feet remain uncovered? What will it cost to finish the uncovered part at 15¢ a square foot?

PLASTERING AND PAINTING

1. How many square yards are there in the ceiling of a room 24 ft. long and 21 ft. wide?

2. How many square yards are there in the walls and ceiling of a room 24 ft. long, 21 ft. wide, if the room is 9 ft. high?

3. How many square yards are there in the walls and ceiling of a room 30 ft. long, 24 ft. wide, 9 ft. high?

4. About 1300 laths are required for every 100 sq. yd. plastering. How many laths are required for 188 sq. yd.?

5. 10 bu. of lime and 10 lb. of hair are required for 100 sq. yd. of plastering. Estimating the lime at 80¢ a bushel and hair 12½¢ a pound, find the cost of the lime and hair necessary for 200 sq. yd. of plastering.

6. Estimating the cost of labor at \$30 for each 100 sq. yd. plastering (two coats), find the cost of the labor for plastering the walls and ceiling of a room 30 ft. long, 24 ft. wide, and 9 ft. high, making a deduction of 54 sq. ft. for doors and windows.

7. How many gallons of ready-mixed paint are required to give two coats to 3000 sq. ft. of surface, estimating that 1 gallon of ready-mixed paint is sufficient to give two coats to 250 sq. ft. of surface?

8. A plasterer makes the following estimate for 100 sq. yd. plastering (two coats). Find the cost:

MATERIAL	QUANTITY	COST PER UNIT	COST
Laths	1300	per 100, \$1.30	
Nails	9 lb.	per pound, 0.10	
Hair	10 lb.	per pound, 0.12½	
Lime	10 bu.	per bushel, 0.80	
Sand	2 T.	per ton, 3.50	
Labor			
Total			<u>\$30.00</u>

9. At the estimate given in example 8, find the cost of plastering a room the size of this schoolroom, making no deductions for doors and windows.

10. Estimate the number of gallons of ready-mixed paint required to give two coats to a building 40 ft. long, 36 ft. wide, and 12 ft. high at one corner, using the rule followed by some painters, which is: Measure in feet the height of the building at one corner and the perimeter in feet; find their product and divide by 250. The result is the number of gallons required for two coats, including two gables.

11. By the rule given in problem 10, find how many gallons of ready-mixed paint are required to give two coats of paint to a building 50 ft. long, 30 ft. wide, and 18 ft. high at one corner.

Measuring Lumber. Lumber is measured by the *board foot*, which is equivalent to a board a foot square and an inch thick. Lumber less than an inch thick is usually considered an inch thick in computing the number of board feet.

If a board is 12 feet long, 1 foot wide, and 1 inch thick, it contains 12 board feet. If a board is 12 feet long, 6 inches wide, and 1 inch thick, it contains 6 board feet.

$$\frac{6 \times 12}{12} = 6.$$

If a piece of lumber is 12 feet long, 6 inches wide, and 3 inches thick, it contains 18 board feet.

$$\frac{3 \times 6 \times 12}{12} = 18.$$

The number of board feet in a piece of lumber is equal to the number of inches in the thickness times the number of inches in the width times the number of feet in the length divided by 12.

MEASURING LUMBER

1. Find the number of board feet in a board 16 ft. long, 12 in. wide, and 1 in. thick.

2. Find the number of board feet in a plank 14 ft. long, 12 in. wide, and 2 in. thick.

3. How many board feet are there in a post 8 ft. long, 6 in. wide, and 6 in. thick (usually written $6'' \times 6'' \times 8'$)?

Find the number of board feet in the following:

4. 10 boards $1'' \times 12'' \times 12'$. 5. 20 boards $1'' \times 6'' \times 12'$.

6. 12 boards $1'' \times 8'' \times 16'$. 7. 24 boards $1'' \times 4'' \times 8'$.

8. 12 boards $1'' \times 4'' \times 12'$. 9. 40 boards $1'' \times 3'' \times 8'$.

10. 30 posts $4'' \times 6'' \times 8'$. 11. 8 planks $2\frac{1}{2}'' \times 12'' \times 12'$.

12. How many board feet are there in a board 16 ft. long, 6 in. wide, and $\frac{1}{2}$ in. thick?

SUGGESTION. In computing the number of board feet, consider as 1 in. thick all boards less than 1 inch thick.

Lumber is usually bought and sold by the *thousand board feet*. Instead of quoting lumber at \$60 per *1000 board feet* a dealer usually quotes it at \$60 per *1000 feet*, which is usually written \$60 per *M*.

13. Find the cost of 20 boards $1'' \times 9'' \times 16'$ at \$60 per *M*.

14. Find the cost of 60 pieces of scantling $3'' \times 4'' \times 12'$ at \$5 per *M*.

15. At \$48 per *M* find the cost of 60 fence boards $1'' \times 6'' \times 12'$.

16. Find the cost of 200 flooring boards $\frac{1}{2}'' \times 3\frac{1}{2}'' \times 16'$ at \$80 per *M*.

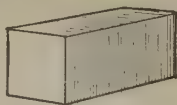
17. At 22¢ a board foot, what is the cost of the oak required to make the following taboret: top, $12'' \times 12'' \times 1''$; bottom, $10'' \times 10'' \times 1''$; four legs, $20'' \times 2'' \times 2''$?

18. At \$60 per *M*, find the cost of a load of lumber consisting of 20 planks $2'' \times 6'' \times 12'$ and 30 boards $1'' \times 12'' \times 16'$.

Solids. A figure which has *length*, *width*, and *thickness* (height depth) is called a *solid*.

For example, this room is a solid. Name four other solids.

Rectangular Solid. A solid bounded by six faces which are rectangles is called a *rectangular solid*. When the six faces are squares, the figure is a *cube*.

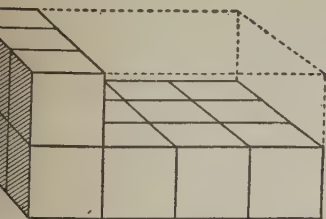


RECTANGULAR SOLID

A crayon box is a rectangular solid. Name four other rectangular solids. Name four solids which are not rectangular solids. Is this room a rectangular solid?

Measuring a Rectangular Solid. To measure a rectangular solid means to find the number of cubic units (cubic inches, cubic feet, or cubic yards) it contains.

This figure represents a rectangular solid 4 units long, 3 units wide, and 2 units high. The number of cubic units in it is found thus:



4 = the number of cubic units in 1 row

3 = the number of rows

3×4 = the number of cubic units in 1 layer

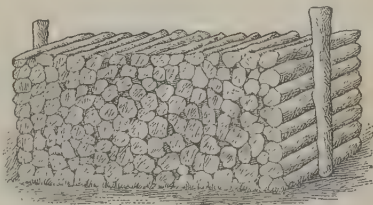
2 = the number of layers

$2 \times 3 \times 4$, or 24, = the number of cubic units in the rectangular solid

The number of cubic units in a rectangular solid equals the number of units in the height, times the number of units in the width, times the number of units in the length.

Wood Measure. A pile of wood 8 ft. long, 4 ft. wide, and 4 ft. high is called a **cord**.

Wood 8 ft. long and 4 ft. high, cut into lengths, is also called a cord.



MEASURES OF RECTANGULAR SOLIDS

1. How many cubic inches will a box hold which is 8 in. long 4 in. wide, and 4 in. deep?
2. How many cubic feet of air are there in a room 40 ft. long 24 ft. wide, and 12 ft. high? How many cubic feet of air are there in your schoolroom?
3. A cubic yard of earth is a *load*. How many loads of earth must be removed in digging a cellar 30 ft. long, 24 ft. wide, and 9 ft. deep?
4. Show that a cord contains 128 cu. ft.
5. A gallon is equal to 231 cu. in. Show that a pan 11 in. long, 7 in. wide, and 3 in. deep holds a gallon.
6. A cubic foot is equal to about .8 of a stricken bushel. At this estimate, how many bushels of wheat will a bin hold that is 6 ft. long, 4 ft. wide, and 4 ft. deep?
7. How many cubic inches are there in a cubic foot?
8. How many gallons of water does a tank hold that is 7 ft. long, $5\frac{1}{2}$ ft. wide, and 3 ft. deep? Cancel.
9. Fred measured his father's mow of hay. It was 30 ft. long 20 ft. wide, and 16 ft. deep. Estimating 400 cu. ft. to a ton, how many tons of hay did the mow contain?
10. A cubic foot of anthracite coal weighs about 54 lb. At this estimate, find how many tons of coal a bin will hold which is 10 ft. long, 9 ft. wide, and 6 ft. deep.
11. A unit of measure for ordinary stone walls is the *perch*. It is a wall $16\frac{1}{2}$ ft. long, $1\frac{1}{2}$ ft. wide, and 1 ft. high. How many cubic feet are there in a perch?
12. How many cubic feet are there in a piece of square timber $9'' \times 9'' \times 12'$?

PIG PROJECTS

1. George pastured 16 spring pigs for 180 da. on alfalfa. He fed them besides on an average 2 lb. of corn each day and .2 lb. tankage. How many bushels of corn (56 lb.) and how many pounds of tankage did he feed them?
2. George bought the corn at 80¢ a bushel and the tankage at .75 per 100 lb. What was the cost of the corn and the tankage?
3. The pigs gained an average of 1.05 lb. each per day. They averaged 10 lb. each when George bought them. What was their combined weight when he sold them at the end of the 180-day period?
4. George sold the 16 pigs at \$12 per 100 lb. What did he receive for them?
5. George paid \$10 each for the pigs and \$15 rent for the alfalfa pasture. What was his total outlay, including the cost of the corn and tankage?
6. What was George's profit from the project?
7. William's father sold him a pig weighing 82.8 lb. He fed it for 12 wk., at the end of which time it weighed 172.1 lb. What was its daily gain, correct to the nearest .01 lb.?
8. William fed his pig a ration of three fourths, by weight, of corn and one fourth ground alfalfa; he fed 429 lb. of both. How many pounds of corn did he feed? How many pounds of ground alfalfa?
9. The corn cost William \$1.60 per 100 lb. and the ground alfalfa 80¢ per 100 lb. What was the cost of the feed?
10. At the end of the 12 weeks' period, William sold his pig at \$12 per 100 lb. He paid his father \$8 for it. How much money did William leave from this project after deducting the cost of the feed also?

KNITTING PROJECTS

1. May knit her own sweater, using 6 balls of Shetland floss which cost 45¢ a ball. Not counting her own time, what did her sweater cost? What did it weigh, each ball of this floss weighing 1.625 oz.?

2. May knit another sweater, using 6 balls of yarn. She paid 45¢ a ball for the yarn and sold the sweater for \$9. She timed herself accurately and found that she made it in 30 hr. How much did she earn per hour?

3. May's mother loaned her the money to buy the yarn (see example 2). After the loan was returned in September, May spent the money she had left for a war savings stamp and as many thrift stamps as the remaining money could buy. How many thrift stamps did she buy?

4. A Tuxedo sweater such as Anna wanted to buy would cost \$18. Anna knew that this sweater could be knit with 10 balls of Scotch yarn costing 65¢ a ball, and also that she could have it knit for \$9. How much would she save by buying the yarn and having the sweater knit? How much would she save by buying the yarn and knitting the sweater herself?

5. Florence gave her sister a Christmas present of a tam o'shanter and a scarf of the kind that were selling for \$9. Florence crocheted the tam and knit the scarf, using for both 7 balls of knitting worsted which cost 60¢ a ball. How much less than the store price did the present cost Florence? Florence is not a fast knitter, but she did this work in 30 hr. What was her time worth per hour?

6. Helen also knit a scarf and crocheted a tam o'shanter, using 6 balls of yarn for which she paid 55¢ a ball. She spent 20 hr. knitting them and sold them for \$7.50. What profit did she make? How much did she earn per hour?

SEWING PROJECTS

1. Edith made a collar and cuff set of organdie embroidered with colored silk. She used $\frac{3}{8}$ yd. of organdie at 75¢ a yard and skeins of colored silk at 5¢ each. What did this set cost her, and what was her saving by making it herself instead of buying at a store for \$3?

2. Eleanor's older sister bought 6 yd. of organdie at \$1 a yard, which she used for a dress for herself. The thread, buttons, etc., cost 50¢. The dress when finished was of the kind that sold in the stores for \$15. What did Eleanor's sister save by making her own dress?

3. Martha paid \$4 a yard for $3\frac{1}{2}$ yd. of tricotine for a dress. She made the dress herself with the exception of pleating the skirt, which cost \$2, and making the collar and cuffs, which cost \$1.50. The snaps used cost 10¢. Martha's dress when finished was just like a \$25 dress in the department store of her home town. How much did she save by making her dress rather than buying the one in the department store?

4. The party dress which Helen wanted was priced \$19.50, but she was more than Helen wanted to pay. She decided to make one like it. The pattern cost 25¢. She bought 5 yd. of taffeta at \$2.25 a yard, $\frac{3}{4}$ yd. belting at 20¢ a yard, 2 spools of silk thread at 20¢ a spool, a dozen clasps at 10¢ a dozen, and $\frac{3}{8}$ yd. of netting at \$1.50 a yard. What did she save by making the dress herself?

5. For a dress for her 2-year-old sister Jane purchased $1\frac{3}{8}$ yd. of flannel at 48¢ a yard, $3\frac{1}{4}$ yd. of insertion at 28¢ a yard, $1\frac{5}{8}$ yd. of ribbon at 40¢ a yard, and thread for 8¢. Jane made the dress herself, which was just like one that was priced \$4.25 in a department store. What did Jane save by making the dress instead of buying the store dress?

GENERAL REVIEW

1. Name the fractions of the following list that are greater than 1; greater than $\frac{1}{2}$; less than $\frac{3}{4}$:

$\frac{1}{4}$ $\frac{5}{4}$ $\frac{3}{2}$ $\frac{3}{8}$ $\frac{11}{8}$ $\frac{5}{16}$ $\frac{9}{16}$ $\frac{7}{8}$ $\frac{4}{4}$ $\frac{9}{10}$

Find the sum of the fractions in each pair; the difference; the product; the quotient of the first divided by the second. Name as many answers as you can at sight.

	<i>a</i>		<i>b</i>		<i>c</i>		<i>d</i>		<i>e</i>		<i>f</i>		<i>g</i>		<i>h</i>	
2.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{7}{8}$	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{1}{2}$	$\frac{5}{6}$	$\frac{2}{3}$
3.	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{4}$	$\frac{7}{8}$	$\frac{3}{8}$	$\frac{5}{6}$	$\frac{1}{3}$	$\frac{5}{8}$	$\frac{5}{12}$	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{7}{10}$	$\frac{2}{5}$
4.	$\frac{4}{5}$	$\frac{3}{10}$	$\frac{3}{4}$	$\frac{3}{10}$	$\frac{9}{10}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{1}{6}$	$\frac{7}{8}$	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{3}{8}$	$\frac{7}{12}$	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{5}{12}$
5.	$\frac{8}{9}$	$\frac{2}{3}$	$\frac{2}{3}$	$\frac{4}{9}$	$\frac{1}{6}$	$\frac{1}{9}$	$\frac{5}{6}$	$\frac{5}{9}$	$\frac{5}{6}$	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{7}{12}$	$\frac{11}{12}$	$\frac{3}{4}$	$\frac{9}{10}$	$\frac{2}{3}$
6.	$\frac{1}{4}$	$\frac{3}{16}$	$\frac{9}{16}$	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{5}{16}$	$\frac{1}{2}$	$\frac{3}{16}$	$\frac{9}{12}$	$\frac{1}{2}$	$\frac{7}{12}$	$\frac{1}{4}$	$\frac{11}{12}$	$\frac{5}{8}$	$\frac{2}{3}$	$\frac{3}{10}$

7. Find the sum of each column in the above table.

8. Count this way: $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, and so on to 1.

9. Count this way: $.12\frac{1}{2}$, $.25$, $.37\frac{1}{2}$, and so on to 1.

10. Draw to a scale of $\frac{1}{4}'' = 1''$ a pane of glass $8''$ by $12''$. How many square inches does the pane contain?

11. Paul's father earns \$2700 a year, working 50 weeks of 6 days each and 8 hours a day. What are his wages per hour?

12. An ordinary brick is $8''$ by $4''$ by $2''$. How many cubic inches does it contain?

13. Estimating the weight of an ordinary brick to be 4.5 lb., how many bricks, correct to the nearest brick, may be loaded on a truck that has a capacity of 2 tons?

14. A wall built of concrete is 30 ft. long, 8 ft. high, and 18 in. thick. How many cubic feet of concrete are there in it?
15. Name six fractions with different denominators which have 12 as their least common denominator.
16. How many cubic inches of rain fall on a square yard of surface for 1 inch of rainfall?
17. Of what denomination is the product when tenths are multiplied by tenths? hundredths by tenths?
18. Of what denomination is the quotient when hundredths are divided by tenths? tenths by tenths?
19. At a testing station a bushel (60 lb.) of clover seed which cost \$21 was tested and found to contain $87\frac{1}{2}\%$ of good seed. What did the good seed cost per bushel?
20. Count this way: $2\frac{1}{2}$, 5, $7\frac{1}{2}$, 10, and so on to 50.
21. Each of the following numbers is what part of 100? what percent of 100? $62\frac{1}{2}$ $87\frac{1}{2}$ $33\frac{1}{3}$ $66\frac{2}{3}$ $8\frac{1}{3}$ $6\frac{2}{3}$
22. Express each of these fractions as a decimal, correct to the nearest ten-thousandth: $\frac{5}{7}$, $\frac{9}{11}$, $\frac{11}{13}$, $\frac{13}{15}$, $\frac{19}{21}$, $\frac{25}{27}$, $\frac{29}{31}$, $\frac{33}{35}$.
23. Name the number of decimal places in each product; then find each product: $.02 \times .02$ $.2 \times .002$ $.2 \times .2$ $.02 \times .002$
- Perform the indicated multiplications:
24. 0.765×0.562 8.04×0.756 0.89×0.675
25. 0.897×6.56 4.68×0.398 8.56×0.876
26. Name the number of decimal places in each quotient; then find each quotient: $.002 \div .02$ $.02 \div .2$ $.002 \div .002$
27. Find each quotient and check:
28. $.2 \div .02$ $.2 \div .002$ $.02 \div .002$ $.2 \div .0002$
- Find the quotients and check:
28. $.25 \div .125$ $10846 \div 2.9$ $.0576 \div 2.4$
29. $57.6 \div 3.2$ $.12 \div 7.5$ $744.8 \div .98$

30. How much is received for a dozen eggs served at a lunch counter at the rate of 2 boiled eggs for 35¢?

31. A rectangular piece of land 88 yd. long and 20 yd. wide contains what part of an acre (4840 sq. yd.)? Draw this rectangle, scale $1'' = 16$ yd.

32. Andrew earned \$20. He put in the bank 25% of the first \$8 he earned, 30% of the next \$5 he earned, and 40% of the rest of his earnings. How much did Andrew put in the bank?

33. For a spray to kill chewing insects 5 oz. of Paris green may be mixed with 50 gal. of water and 1 lb. of fresh-burned lime. How much of each ingredient must be used to make half the quantity? To make twice the quantity?

34. The children of Grade 6 had a test of 20 words in spelling. Arthur had 19 right, Alice had 18 right, Anna had 20 right, Mabel had 17 right, and John had 16 right. What per cent of the 20 words did each pupil have right?

35. Under ordinary conditions of weather and soil, cabbage will yield 15,000 lb. to the acre. How many tons should $1\frac{3}{4}$ acres produce?

36. The weight of dressed hogs is about .8 lb. to each 1 lb. of their live weight. How much should a hog weigh when dressed, if its live weight is 265 lb.?

37. Counting that 1 cu. ft. = 7.48 gal., how many gallons are there in a tank $6' \times 4' \times 8'$ when it is half full?

38. In heating value one standard cord of well-seasoned hickory, oak, or beech is about equal to 1 ton (2000 lb.) of anthracite coal. The heating value of $2\frac{1}{2}$ cords of well-seasoned oak has the heating value of how many tons of anthracite coal?

REMARK. This estimate is by the Forest Service of the U. S. Department of Agriculture.

39. The dressed weight of a steer is estimated at 60% of its live weight. Estimate the dressed weight of a steer whose live weight is 875 lb.
40. Fred tests his seed sweet corn. He plants 50 seeds, and, the seed is in good condition, 9 out of every 10 grains should germinate. How many of the 50 grains should germinate? What per cent of the 50 grains should germinate?
41. What should a farmer receive for 5130 lb. of wheat at \$.20 per bushel (60 lb.)? at \$2.17 per cwt.?
42. Find the cost of 2 lb. 12 oz. of butter at 56¢ a pound.
43. How many 2-inch cubes can be cut from a block of wood $8'' \times 8'' \times 4''$, if the block is in the form of a rectangular solid and no allowance is made for waste?
44. Draw a rectangle $8'' \times 6''$. Shade $62\frac{1}{2}\%$ of it. $12\frac{1}{2}\%$ of it.
45. What discount is allowed on a suit marked \$50 and sold for \$42?
46. Eggs of a good size should weigh about $2\frac{1}{4}$ oz. each. What should be the weight of a dozen such eggs? Weigh a dozen eggs and compare their weight with your answer.
47. Mr. Davis planted in corn a field 48 rd. long and 20 rd. wide. Reckoning the time of a man and a team at \$5 a day, what did it cost to:
- Plow the field at the rate of 2 acres a day?
 - Harrow the field three times at the rate of 12 acres a day?
 - Drill the field at the rate of 12 acres a day?
 - Cultivate the field four times at the rate of 6 acres a day?
48. Find the cost of 2000 yd. of wire at 1¢ a foot.
49. To find about how many tons in a mow of new hay, divide the number of cubic feet by 500. How many tons in a mow of hay 30 feet long, 20 feet deep, and 16 feet wide?

50. Find the cost of shipping 600 baskets of pears weighing 50 lb. each at 25¢ per hundred pounds.

51. I have floor space $7\frac{1}{2}$ ft. by 4 ft. on which I wish to build a bin just large enough to hold 120 bu. of wheat. Allowing $\frac{1}{4}$ of a cubic foot for a bushel, how high must the bin be made?

52. Make out Frank's bill for cutting Mr. Martindale's lawn and cleaning the walks during August. He worked 9 hr. Aug. 1; 7 hr. Aug. 9; 6 hr. Aug. 16; 6 hr. Aug. 23; 6 hr. Aug. 30. His wages were 20¢ an hour. When Frank received his wages Sept. 1, he bought a war savings stamp. How much money had he left?

53. Find the cost of 24 ft. of poultry wire 30 in. wide at 3¢ a square foot.

54. In a recent year the United States sold Brazil .47 of the latter's total imports valued at \$102,000,000. What was the amount of these sales? What is meant by *imports*?

55. A prize Holstein Friesian cow has a record of an average yearly production for six years of: milk, 25,629.4 lb.; butter, 1185.92 lb. How many pounds of milk did she produce in the six years? How many pounds of butter? Can you find out what is the best record made by a cow of your state? Weigh a quart of milk and tell the class what you found its weight to be.

56. In a recent year Rolo Mercena de Kol was sold as the World's champion cow for \$26,000. She then had a record of 51.17 lb. of butter in 7 days, and 201.17 lb. in 30 days. At 50¢ a pound, what was her 7-day production of butter worth?

57. Hay well dried in the field loses about $\frac{1}{3}$ of its weight if allowed to dry out and pack in the mow; 12 tons of dry hay from the field will weigh how much when dried out and settled in the mow?

58. What does a family save by buying a ton of coal for \$13 instead of buying it by the bucket at 40¢ a bucket, if 56 buckets of the size bought make a ton?

59. \$10,000 is to be collected for a community house. At the beginning of a certain day \$8570 had been collected. During the day five collectors reported as follows: \$275, \$180, \$270, \$125, and \$380. How much more is needed? What per cent of the \$10,000 is collected?

60. A produce dealer bought 30 bu. of potatoes at \$1.10 a bushel and retailed half of them at 50¢ a peck and half of them at 30¢ a half peck. What was his profit?

61. A good feed for poultry can be made by mixing 200 lb. of wheat bran, 100 lb. of middlings, and 100 lb. of corn meal. What part of the mixture is wheat bran? What part is corn meal? How many pounds of wheat bran and how many pounds of middlings must be used with 50 lb. of corn meal?

62. A boy has 63 customers for a city evening paper and 40 for the local afternoon paper. His profit on the city paper is $\frac{2}{3}$ cent a copy and on the local paper 12¢ on 20 copies. How much does he earn in a week (6 days)?

63. Draw to a scale of $\frac{1}{8}'' = 1''$ three triangles, each with base 10 inches, and altitude 16 inches, one having an obtuse angle, one having a right angle, and the third having three acute angles. Find the area of each.

64. The New York City Department of Health selected these articles because of their food value as providing ample nourishment for one week for a family of five — two adults and three children; at the prices at which these articles are now selling in your vicinity, find the cost of this one week's food supply:

1 lb. butter	1 lb. oatmeal	1 lb. cheese
$\frac{1}{2}$ lb. sugar	$\frac{1}{4}$ lb. cocoa	2 doz. eggs
1 lb. rice	1 lb. onions	2 lb. meat daily
1 lb. dried peas	6 lb. potatoes	2 loaves bread daily
1 lb. beans	1 head cabbage	2 qt. milk daily
1 lb. farina		1 lb. prunes

TABLES OF DENOMINATE AMOUNTS

TABLES OF DENOMINATE AMOUNTS

(For Reference)

Liquid Measure

4 gills = 1 pint
 2 pints = 1 quart
 4 quarts = 1 gallon
 31½ gallons = 1 barrel
 2 barrels = 1 hogshead
 1 gallon = 231 cu. in.

Dry Measure

2 pints = 1 quart
 2 quarts = 1 small measure
 8 quarts = 1 peck
 4 pecks = 1 bushel

Linear Measure

12 inches = 1 foot
 3 feet = 1 yard
 5½ yards = 1 rod
 320 rods = 1 statute mile

Avoirdupois Weight

16 ounces = 1 pound
 100 pounds = 1 hundredweight
 2000 pounds = 1 short ton
 2240 pounds = 1 long ton

Square Measure

144 square inches = 1 square foot
 9 square feet = 1 square yard
 30¼ square yards = 1 square rod
 160 square rods = 1 acre
 640 acres = 1 square mile

Weights of Everyday Things

A barrel of flour 196 lb.
 A barrel of salt 280 lb.
 A barrel of pork, beef, or fish 200 lb.
 A bushel of coarse salt 56 lb.
 A bushel of Portland cement 96 lb.
 A bushel of loose lime 70 lb.
 A cubic foot of water 62½ lb.
 400 cu. ft. of hay in the mow 1 ton

Cubic Measure

1728 cubic inches = 1 cubic foot
 27 cubic feet = 1 cubic yard
 1 cubic yard of earth is called a load.

Weights of a Bushel of Grain, Seed, and Other Produce

COMMODITIES	LB.	COMMODITIES	LB.
Barley	48	Oats	32
Beans	60	Peas	60
Bran	20	Potatoes	60
Corn (shelled)	56	Rye	56
Corn (on cob)	70	Timothy seed	45
Clover seed	60	Wheat	60

Time

60 seconds = 1 minute
 60 minutes = 1 hour
 24 hours = 1 day
 7 days = 1 week
 52 weeks = 1 year (nearly)
 365 days = 1 common year
 366 days = 1 leap year
 100 years = 1 century

United States Money

10 mills = 1 cent
 10 cents = 1 dime
 10 dimes = 1 dollar
 10 dollars = 1 eagle

INDEX

- accuracy and speed tests: addition, 6, 7, 8, 9, 10, 38, 147, 148; subtraction, 15, 16, 19, 38, 149, 150; multiplication, 23, 24, 28, 39, 150; division, 31, 36, 39, 152; fractions, 64, 82, 83, 115, 116, 161, 162; decimals, 115, 116, 197, 198, 199.
 addition, of integers, 6-14, 38, 147-149; of compound amounts, 133, 248-251; of decimals, 96-97, 178-180, 197; of fractions, 45, 50, 56-58, 161-162.
 amounts, 6.
 angles, 252.
 areas, 129-131, 253-264.
 balancing accounts, 22.
 bills, 109-111.
 building lots, problems about, 257.
 cancellation, 66-67, 155-156.
 computing, 264.
 cash accounts, 21.
 checking results, 7, 18, 25, 33.
 checks, 242.
 commission, 234-236.
 common denominator, 54.
 common fractions, 90, 172; reducing to decimals, 188 (see fractions).
 comparison, 81, 165.
 complex fractions, 167.
 compound amounts, 133-136, 247-252.
 cube, 151, 269.
 cubic measure, 131.
 decimal point, 11.
 decimals, 89-117, 172-210; accuracy and speed tests, 115-116, 197-199; defined, 89-172; addition, 96-97, 178-180; division, 104-108, 184-190; multiplication, 100-104, 180-183; reading and writing, 89-93, 172-177; reducing common fractions to, 188; reduction, 93, 177; subtraction, 98-100, 178-180.
 Denominate amounts, tables of, 280.
 Denominator, defined, 48; common, 54; least common, 55.
 Discount, trade, 226-229.
 Dividend, 30.
 Divisibility, 154.
 Division, of compound amounts, 136, 251-252; of decimals, 104-108, 184-190, 199; of fractions, 75-80, 164; of integers, 30-37, 39, 152-155.
 Divisor, 30.
 Dry measure, 119.
 Equivalents — per cent, decimal, and fractional, 212.
 Even number, 154.
 Factors, 30, 153.
 Farm projects, 195.
 Fractions, 42-88, 160-171; accuracy and speed tests, 64, 82-83, 115-116, 161-162; addition, 45, 50, 56-58, 161-162; cancellation, 66; common fractions, 90, 172, 188; complex, 167; division, 75-80, 164; finding the whole when a part is given, 166; improper, 51; inverting, 77; least common denominator, 55, 161; multiplication, 65-74, 163; proper, 51; reduction, 49-55; similar, 54; subtraction, 46, 50, 56, 59-65, 162; terms of, 48.
 Fractional parts of whole numbers, 47.
 Fractional unit, 76.
 Fundamental operations, 1-41, 145-159.
 General review, 137, 274.
 Home gardening, 126, 258-259.
 Improper fraction, 51.
 Integers, 42.
 Interest, 236-241.
 Knitting projects, 272.

Least common denominator, 55, 161.

Length, measures of, 124-126.

Liquid measure, 118.

List price, 226.

Long division, 34-36.

Lumber, measuring, 267-268.

Making change, 17.

Measures, 118-136, 244-270; review and use of tables, 244-247.

Minuend, 14.

Mixed numbers, 42, 52.

Multiplicand, 22.

Multiplication, of compound amounts, 135, 251-252; of decimals, 100-104, 180-183, 198; of fractions, 65-74, 163; of integers, 22-29, 39, 150-151.

Multiplier, 22.

Net price, 226.

Numerator, 48.

Odd number, 154.

Parallel lines, 253.

Parallelogram, 260, 261.

Parcel post, 190, 191-193.

Percentage, 211-243; commission, 234-236; equivalents in per cents, decimals, and fractions, 212; finding a given per cent of a number, 213-217; finding a number when a per cent of it is given, 217-219; finding what per cent one number is of another, 219-221; interest, 236-241; meaning of, 211; profit and loss, 229-234; promissory notes, 240; the three problems of, 222; trade discount, 226-229.

Periods, 3.

Pig projects, 271.

Place value, in decimals, 92; in integers, 2.

Plane surface, 253, 260-264.

Plastering and painting, 266.

Prime factors, 153.

Prime number, 153.

Product, 22.

Profit and loss, 229-234.

Projects, farm, 195-196; home garden, 126, 258; knitting, 272; pig, 271; sewing, 273.

Promissory notes, 240-241.

Proper fraction, 51.

Quadrilateral 260.

Quotient, 30.

Reading and writing, whole numbers, 1-5, 146; decimals, 89-93, 172-177.

Receipts, 243.

Rectangles, 129-131, 254-257.

Remainder, 14, 30.

Roman numerals, 5.

Sewing projects, 273.

Short division, 31-33.

Similar fractions, 54.

Solids, 269-270.

Square, 151, 253.

Square measure, 128.

Subtraction, of compound amounts, 134, 248-251; of decimals, 98-100, 178-180, 197; of fractions, 46, 50, 56, 59-65, 162; of integers, 14-21, 38, 149-150.

Subtrahend, 14.

Surface, 253.

Tables of denominate amounts, 280.

Thrift, 112, 193.

Time, measures of, 122-124.

Trade discount, 226-229.

Trapezoid, 260, 263-264.

Triangle, 260, 262.

United States money, 11, 94, 108.

United States postage, 190-193.

Unit, 6.

Unlike fractions, 57.

Uses of numbers, 1.

Weight, measures of, 120-122.

Wood measure, 269.

ANDERSON ARITHMETIC, BOOK TWO. ANSWERS

Page 5. — 2. See Book One, page 84. 4. MDCCCLXXXIX; MCMXVII; MDCCCIII; MCMXXVI; MDCCCXX; MCMXXX. Page 6. — 5. 24; 41; 4; 95; 1900; 1924; 1492. Page 7. — 2. 7; 16; 18; 15; 23; 24; 19; 22; 30; 28; 9; 34; 33; 30; 35. Page 8. — 3. *a.* 35; *b.* 32; *c.* 40; *d.* 44; *e.* 46; *f.* 44; *g.* 53; *h.* 46; *i.* 41; *j.* 49; *k.* 47; *l.* 30; *m.* 48; *n.* 44; *o.* 43. 1. *a.* 46; *b.* 39; *c.* 43; *d.* 52; *e.* 51; *f.* 48; *g.* 55; *h.* 57; *i.* 71; *j.* 56; *k.* 45; *l.* 52; *m.* 63; *n.* 59; *o.* 69. Page 9. — 1. *a.* 147; *b.* 217; *c.* 188; *d.* 221; *e.* 236; *f.* 269. 2. *a.* 171; *b.* 290; *c.* 292; *d.* 369; *e.* 336; *f.* 501. Page 10. — 3. 588. 4. 5687. 1. 3507. 2. 4913. 3. 5055. 4. 4995. 5. 4997. 6. 4984. 7. 4999. 8. 5506. 9. 5455. 10. 6110. 11. 5698. 12. 6748. Page 12. — 6. \$44.75. 7. \$45.16. 8. \$41.01. 9. \$48.97. 10. \$58. 1. 74 da. 2. 59. 3. 70¢. 4. 16. 5. 145. Page 13. — 7. 48 yr.; 4 yr. 8. 410. 9. \$1909.49. 10. 66¢. 11. 324. 12. 740 yr. 13. \$35. Page 14. — 14. 160. 15. \$27.55. 16. \$11.20. 17. 36¢. Page 18. — 1. 555; *b.* 633; *c.* 155; *d.* 527; *e.* 533; *f.* 428. Page 19. — 2. *a.* 3107; *b.* 3146; *c.* 4022; *d.* 963; *e.* 1904; *f.* 2397. 3. *a.* 2819; *b.* 4810; *c.* 4533; *d.* 6999; *e.* 4989; *f.* 5895. 4. \$2.50. 5. \$15.10. 6. \$38.30. 7. \$4.25. 8. \$17.65. 9. \$40.62. 10. 373,486,250. 11. 140,543,261. 12. 37,013,841. 13. 161,205,963. 14. 73,520,333. 15. 2,895,274. 16. 99,007,866. 17. 81,523,414. 18. 763,779,210. 19. 64,38,905. 20. 79,487,529. 21. 85,592,661. Page 20. — 1. 22. 2. \$28. 3. \$4. 4. 175. 5. 18¢. 6. 75¢; 88¢; \$1.63; 13¢. 7. First week: bought 465, unsold 3, sold 432; second week: bought 520, unsold 48, sold 472. Page 21. — 8. 32. Page 22. — 1. \$1.90. 2. \$2.50. Page 25. — 1. *a.* 5156; *b.* 9972; *c.* 12,219; *d.* 17,607; *e.* 10,388; *f.* 13,872. 2. *a.* 13,975; *b.* 43,015; *c.* 55,284; *d.* 50,256; *e.* 51,436; *f.* 18,613. 3. *a.* \$149.84; *b.* \$118.90; *c.* \$329.52; *d.* \$497.63; *e.* \$136.80; *f.* \$444.42. 4. *a.* \$567.52; *b.* \$612.63; *c.* \$303.12; *d.* \$364.96; *e.* \$662.31; *f.* \$565.56. Page 27. — 6. \$1.75; \$1.25. 7. \$104. 8. \$90. 9. \$38.40. Special Forms. Reading from left to right: 1,430,000; 22,355,456; 4,730,125; 1,502,720; 9,896,796; 24,512,640; 63,639,648; 17,386,551; 39,951,300. Page 28. — 1. *a.* 115,236; *b.* 189,687; *c.* 221,821; *d.* 624,896. 2. *a.* 2,225,000; *b.* 258,825; *c.* 414,903; *d.* 1,784,592. 3. *a.* 743,212; *b.* 6,685,080; *c.* 121,814; *d.* 4,300,560. 4. *a.* 439,362; *b.* 673,204; *c.* 784,116; *d.* 108,468. 5. 847,214; 998,629; 1,378,855; 2,277,243; 2,578,601. 6. 1,717,976; 4,050,686; 2,794,570; 15,362; 5,226,134. 7. 2,364,332; 5,577,602; 3,847,990; 6,355,134; 7,196,138. 8. 25,506; 4,778,291; 3,296,545; 5,444,397; 6,164,879. 9. 2,539,258; 5,990,263;

4,132,685; 6,825,321; 7,728,547. 10. 3,893,136; 29,284,398; 19,141,252; 47,776,794; 57,337,878. 11. 2,753,184; 20,709,612; 13,536,488; 33,787,236; 40,548,732. 12. 2,796,432; 21,034,926; 13,749,124; 34,317,978; 41,185,686. 13. 3,394,152; 25,531,011; 16,687,914; 41,653,233; 49,988,871. 14. 3,481,056; 26,184,708; 17,115,192; 42,719,724; 51,268,788. 1. 42¢. 2. \$140; \$70. Page 29.—3. \$3. 4. 1440. 5. 33¢. 6. \$2.94. 7. 83¢. 8. \$3.60. 9. 18,000. 11. \$1000. 12. \$8.38. 13. \$777.60. 14. \$930. Page 33.—1. a. 6285; b. 2865; c. 3784; d. 6248. 2. a. 4628; b. 9263; c. 7943; d. 3794. 3. a. 7953; b. 5478; c. 3629; d. 4857. 4. a. 2396; b. 3895; c. 5487; d. 7426. 5. a. \$14.25; b. \$20.75; c. \$86.40; d. \$95.38. Page 35.—1. a. 2; b. 2; c. 3, rem. 2; d. 4, rem. 1; e. 5, rem. 2; f. 7, rem. 2. 2. a. 3, rem. 4; b. 4, rem. 9; c. 5, rem. 12; d. 6, rem. 10; e. 7, rem. 15; f. 7, rem. 9. 3. a. 3, rem. 6; b. 2, rem. 26; c. 4, rem. 8; d. 3, rem. 25; e. 3, rem. 34; f. 3, rem. 36. 4. a. 46; b. 38, rem. 15; c. 43, rem. 10; d. 32, rem. 6; e. 24; f. 32, rem. 4. 5. a. 35, rem. 19; b. 35; c. 37; d. 27, rem. 9; e. 26, rem. 25; f. 25, rem. 12. 6. a. 56; b. 53, rem. 19; c. 87, rem. 44; d. 56, rem. 31; e. 55, rem. 41; f. 52, rem. 30. 7. a. 31, rem. 55; b. 32, rem. 40; c. 52, rem. 40; d. 64, rem. 43; e. 67, rem. 61; f. 74, rem. 62. 8. 123. 9. 804. 10. 234. 11. 586. 12. 124. 13. 907. 14. 724. 15. 486. 16. 506. 17. 809. 18. 898. 19. 806. 20. 999. 21. 999. 22. 964. Page 36.—1. 408. 2. 691. 3. 341. 4. 270. 5. 200, rem. 28. 6. 460. 7. 219. 8. 521. 9. 209. 10. 580. 11. 319, rem. 34. 12. 406. 13. 920. 14. 805. 15. 713. 16. 640. 2. 17, rem. 185. 3. 18, rem. 285. 4. 12, rem. 325. 5. 9, rem. 25. 6. 7, rem. 251. 7. 6, rem. 358. 8. 8, rem. 25. 9. 7, rem. 375. 10. 6, rem. 100. Page 37.—12. 21, rem. 116. 13. 23, rem. 145. 14. 25, rem. 78. 15. 34, rem. 129. 16. 24, rem. 128. 17. 20, rem. 47. 18. 57, rem. 25. 19. 56, rem. 6. 20. 76, rem. 116. 1. \$1; 40¢. 2. 30¢. 3. 10 yr. 4. 91 yr. 5. 220; 10. 6. \$45.50. 7. \$6.48. Page 38.—1. 4916. 2. 5843. 3. 4976. 4. 5010. 5. 5821. 6. 5648. 7. 5990. 8. 5570. 9. 99,007,866. 10. 81,523,414; 11. 64,988,905. 12. 79,487,529. 13. 763,779,210. 14. 73,520,483. 15. 2,895,274. 16. 85,592,661. 17. 161,205,963. 18. 373,486,250. 19. 140,543,261. 20. 37,013,841. Page 39.—1. a. 443,760; b. 542,868; c. 143,608; d. 366,184. 2. a. 405,426; b. 132,732; c. 594,336; d. 702,828. 3. a. 333,522; b. 702,696; c. 655,200; d. 269,780. 4. a. 507,224; b. 313,464; c. 508,560; d. 288,788. 5. a. 209; b. 570; c. 904; d. 705. 6. a. 920; b. 781; c. 218; d. 217. 7. a. 304; b. 218; c. 851; d. 690. 8. a. 430; b. 821; c. 906; d. 570. Page 40.—3. \$4.90. 4. 24¢. 5. \$105. 6. \$225. 7. \$21.46. Page 41.—8. \$2240. 9. \$322; \$482.25; \$210.25; \$569.25; \$526.25; \$690. 10. \$485. 11. \$150.40. Page 46.—5. a. 1; b. $\frac{2}{3}$; c. $\frac{1}{2}$; d. $\frac{5}{8}$; e. $1\frac{1}{2}$; f. $1\frac{1}{2}$; g. $1\frac{1}{2}$; h. $1\frac{1}{6}$. 6. $2\frac{1}{3}$. 7. a. $2\frac{2}{3}$; b. 4; c. $2\frac{2}{3}$; d. $3\frac{5}{8}$; e. $4\frac{1}{3}$; f. $4\frac{1}{6}$; g. $5\frac{5}{8}$; h. $4\frac{1}{2}$. 2. $\frac{1}{6}$ ft.; $\frac{1}{8}$ ft. 4. a. $\frac{1}{3}$; b. $\frac{2}{3}$; c. $\frac{1}{6}$; d. $1\frac{1}{2}$; e. $2\frac{1}{2}$; f. $\frac{1}{6}$; g. $\frac{1}{4}$; h. $\frac{1}{6}$. Page 47.—5. $1\frac{5}{8}$ yd. 6. a. $1\frac{1}{8}$; b. $2\frac{1}{3}$; c. $1\frac{1}{6}$; d. $1\frac{1}{2}$; e. $2\frac{1}{2}$; f. $2\frac{1}{2}$; g. $2\frac{1}{8}$; h. $1\frac{5}{8}$. Page 51.—2. $\frac{1}{2}$; $\frac{1}{4}$; $\frac{1}{2}$; $\frac{3}{4}$; $\frac{5}{8}$; $\frac{7}{8}$; $\frac{1}{2}$; $\frac{1}{2}$; $\frac{5}{8}$; $\frac{3}{4}$. 3. $3\frac{1}{4}$; $3\frac{1}{2}$; $2\frac{3}{8}$; $3\frac{3}{8}$; $3\frac{3}{4}$; $4\frac{1}{2}$; $3\frac{3}{8}$; $2\frac{3}{4}$; $2\frac{5}{8}$; $3\frac{3}{4}$. 5. $\frac{1}{2}$; $\frac{1}{4}$; $\frac{2}{3}$; $\frac{1}{6}$; $\frac{1}{8}$; $\frac{1}{2}$; $\frac{1}{4}$; $\frac{1}{8}$; $\frac{1}{2}$; $\frac{2}{5}$. 6. $\frac{1}{2}$; $\frac{1}{8}$; $1\frac{1}{2}$

$2\frac{1}{3}$; $1\frac{1}{2}$; $1\frac{2}{3}$; $1\frac{1}{3}$; $1\frac{1}{3}$; $2\frac{1}{2}$. Page 53. — 3. $\frac{3}{2}$; $\frac{5}{2}$; $\frac{4}{3}$; $\frac{7}{6}$; $1\frac{1}{6}$; $1\frac{5}{8}$; $1\frac{8}{5}$; $2\frac{9}{8}$; $\frac{2}{3}$; $\frac{5}{6}$. 4. $\frac{7}{3}$; $\frac{7}{2}$; $1\frac{6}{4}$; $\frac{7}{4}$; $1\frac{1}{4}$; $1\frac{5}{4}$; $1\frac{0}{4}$; $\frac{5}{9}$; $\frac{3}{2}$; $\frac{7}{4}$. 5. $\frac{8}{3}$; $1\frac{5}{2}$; $2\frac{5}{4}$; $2\frac{5}{3}$; $\frac{5}{3}$; $\frac{0}{4}$; $\frac{5}{9}$; $\frac{4}{5}$; $2\frac{5}{2}$; $\frac{7}{2}$. 6. $\frac{1}{3}$; $\frac{9}{2}$; $2\frac{5}{3}$; $1\frac{0}{3}$; $2\frac{0}{3}$; $1\frac{2}{7}$; $2\frac{0}{9}$; $8\frac{0}{7}$; $\frac{0}{9}$. 7. 2; 4; 10; 4; 8; 20; 10; 20; 50. 8. 27. 9. 25. 10. See explanation of page 52. Page 54. — 3. 1; $1\frac{1}{2}$; $3\frac{1}{2}$; $4\frac{1}{2}$; $7\frac{1}{2}$; $5\frac{1}{2}$; $12\frac{1}{2}$; $37\frac{1}{2}$; $13\frac{1}{3}$; $6\frac{2}{3}$. $1\frac{2}{3}$; $2\frac{2}{3}$; $1\frac{1}{3}$; $2\frac{1}{4}$; $3\frac{1}{3}$; $3\frac{3}{4}$; $3\frac{1}{4}$; $6\frac{1}{4}$; $18\frac{3}{4}$; $16\frac{2}{3}$. 5. $1\frac{1}{3}$; $1\frac{1}{2}$; $1\frac{2}{3}$; $1\frac{1}{4}$; $3\frac{1}{8}$; $9\frac{3}{8}$; $2\frac{5}{8}$; $2\frac{1}{2}$; $2\frac{1}{6}$. 6. $4\frac{1}{6}$; $2\frac{1}{2}$; 20; $62\frac{1}{2}$; $87\frac{1}{2}$; $33\frac{1}{3}$; $66\frac{2}{3}$; $11\frac{1}{9}$; $14\frac{2}{9}$; $22\frac{2}{9}$. 7. 3. 8. $1\frac{1}{2}$. $1\frac{1}{8}$; 4 in. Page 56. — 11. a. $2\frac{3}{4}$; $1\frac{3}{4}$; b. $3\frac{5}{6}$; $7\frac{5}{6}$; c. $1\frac{3}{8}$; $2\frac{3}{8}$; d. $1\frac{4}{12}$; $1\frac{8}{12}$; $4\frac{6}{12}$; $2\frac{8}{12}$; f. $5\frac{9}{12}$; $2\frac{8}{12}$. 12. a. $2\frac{9}{12}$; $3\frac{10}{12}$; b. $1\frac{5}{10}$; $2\frac{4}{10}$; c. $3\frac{9}{24}$; $2\frac{10}{24}$; d. $2\frac{8}{20}$; $5\frac{5}{20}$; e. $3\frac{16}{24}$; $5\frac{15}{24}$; f. $7\frac{9}{24}$; $2\frac{20}{24}$. Page 57. — 1. The sums: $\frac{2}{3}$; $\frac{4}{5}$; $\frac{7}{9}$; $\frac{6}{7}$; 1; 1; 1; $1\frac{1}{5}$; $1\frac{1}{9}$; $1\frac{1}{3}$; $1\frac{2}{3}$. The differences: 0; $\frac{2}{5}$; $\frac{1}{3}$; $\frac{4}{7}$; $\frac{1}{5}$; $\frac{2}{3}$; $\frac{3}{4}$; $\frac{1}{5}$; $\frac{2}{5}$; $\frac{1}{3}$; $\frac{2}{9}$; $\frac{1}{9}$. 2. The sums: $\frac{2}{3}$; $\frac{2}{5}$; $\frac{1}{4}$; $\frac{7}{8}$; $\frac{4}{5}$; $1\frac{1}{3}$; $1\frac{1}{8}$; $1\frac{1}{3}$; $1\frac{1}{5}$; $1\frac{1}{4}$; 1; $1\frac{1}{2}$. The differences: $\frac{1}{2}$; $\frac{1}{5}$; $\frac{1}{8}$; $\frac{1}{2}$; $\frac{1}{2}$; $\frac{3}{4}$; $\frac{4}{9}$; $\frac{1}{5}$; $\frac{5}{8}$; $\frac{3}{8}$; $\frac{3}{8}$. 1. $\frac{3}{4}$; $1\frac{1}{6}$; $\frac{2}{3}$; $1\frac{1}{3}$; $\frac{5}{6}$; $1\frac{1}{6}$; $\frac{1}{2}$; $1\frac{1}{2}$; $\frac{4}{5}$; $1\frac{1}{5}$. 2. $\frac{7}{8}$; $1\frac{1}{8}$; $1\frac{1}{6}$; $\frac{7}{10}$; $1\frac{1}{10}$; $\frac{7}{4}$; $1\frac{7}{12}$; $1\frac{1}{5}$; $1\frac{1}{15}$. 3. $\frac{1}{6}$; $1\frac{2}{5}$; $\frac{3}{5}$; $1\frac{1}{4}$; $\frac{1}{20}$; $1\frac{1}{20}$; $\frac{7}{20}$; $1\frac{5}{4}$; $\frac{1}{10}$; $\frac{1}{5}$. 4. $\frac{1}{10}$; $1\frac{1}{10}$; $\frac{3}{4}$; $1\frac{1}{2}$; $\frac{9}{10}$; $1\frac{2}{5}$; $1\frac{1}{8}$; $1\frac{1}{4}$; $\frac{5}{6}$; $1\frac{1}{10}$. 5. $\frac{1}{6}$; $1\frac{1}{6}$; $\frac{4}{5}$; $1\frac{1}{3}$; $\frac{1}{20}$; $\frac{1}{4}$; $1\frac{1}{8}$; $\frac{7}{10}$; $1\frac{1}{6}$. Page 58. — 1. $\frac{1}{8}$ mi. 2. $\frac{1}{16}$ mi. 3. $\frac{1}{4}$ mi. 4. $\frac{1}{4}$ mi. $\frac{1}{4}$ mi. 6. $\frac{1}{16}$ mi. 7. $\frac{3}{8}$ mi. 8. $\frac{1}{4}$ mi.; $\frac{1}{2}$ mi.; $\frac{9}{16}$ mi.; $\frac{5}{8}$ mi. Page 59. — 1. $\frac{1}{6}$; b. $\frac{5}{8}$; c. $\frac{1}{4}$; d. $\frac{1}{6}$; e. $\frac{1}{8}$; f. $\frac{3}{10}$; g. $\frac{1}{12}$; h. $\frac{9}{16}$; i. $\frac{5}{16}$; j. $\frac{1}{16}$. 2. a. $\frac{1}{8}$; b. $\frac{1}{2}$; $\frac{1}{4}$; d. $\frac{1}{2}$; e. $\frac{1}{6}$; f. $\frac{1}{5}$; g. $\frac{1}{5}$; h. $\frac{1}{4}$; i. $\frac{1}{3}$; j. $\frac{1}{4}$. 3. a. $\frac{1}{6}$; b. $\frac{1}{10}$; c. $\frac{3}{10}$; d. $\frac{7}{24}$; e. $\frac{4}{15}$; $\frac{1}{4}$; g. $\frac{1}{15}$; h. $\frac{1}{20}$; i. $\frac{1}{15}$; j. $\frac{1}{30}$. 4. a. $\frac{1}{12}$; b. $\frac{7}{12}$; c. $\frac{1}{12}$; d. $\frac{1}{14}$; e. $\frac{1}{24}$; f. $\frac{1}{24}$; $\frac{7}{24}$; h. $\frac{1}{24}$; i. $\frac{5}{24}$; j. $\frac{7}{24}$. 5. a. $\frac{2}{15}$; b. $\frac{1}{15}$; c. $\frac{1}{15}$; d. $\frac{1}{15}$; e. $\frac{1}{15}$; f. $\frac{1}{15}$; g. $\frac{1}{10}$; $\frac{1}{15}$; i. $\frac{1}{6}$; j. $\frac{7}{10}$. Page 60. — 1. $\frac{1}{4}$ hr. 2. $\frac{1}{12}$; 35. 3. $\frac{2}{5}$; 24. 4. $\frac{1}{8}$ yd. 5. $\frac{3}{8}$. 6. $\frac{1}{2}$; $\frac{1}{12}$; $\frac{5}{8}$; $\frac{2}{3}$; $\frac{5}{4}$. 7. 20¢; $\frac{1}{6}$; 2. 8. $\frac{1}{8}$ in.; $\frac{3}{8}$ in.; $\frac{1}{4}$ in. 9. $\frac{2}{3}$; $\frac{9}{16}$; $\frac{3}{8}$. 10. $\frac{3}{8}$. Page 61. — 1. 4. 2. 6. 3. $5\frac{1}{5}$. 4. $5\frac{3}{4}$. 5. $10\frac{1}{3}$. 6. $7\frac{1}{12}$. 7. $12\frac{1}{6}$. 8. 2. 9. $19\frac{1}{6}$. 10. $9\frac{1}{6}$. 11. $10\frac{1}{4}$. 12. $7\frac{1}{6}$. 13. $12\frac{2}{9}$. 14. $8\frac{1}{2}$. 15. $6\frac{1}{3}$. 16. 17. 64. 18. \$12.80. Page 62. — 1. $2\frac{1}{2}$; $6\frac{1}{3}$; $5\frac{5}{6}$; $4\frac{2}{3}$; $7\frac{1}{2}$; $27\frac{1}{2}$; $2\frac{7}{2}$; $12\frac{1}{2}$; $\frac{1}{2}$. 3. a. 3; b. $4\frac{1}{2}$; c. $7\frac{2}{3}$; d. $5\frac{1}{4}$; e. $7\frac{1}{2}$; f. $7\frac{1}{3}$; g. $6\frac{5}{8}$; h. $5\frac{1}{3}$. 4. a. $2\frac{1}{2}$; b. $1\frac{1}{3}$; c. $11\frac{3}{4}$; $7\frac{5}{8}$; e. $4\frac{3}{4}$; f. $6\frac{1}{2}$; g. $4\frac{5}{8}$; h. $6\frac{7}{10}$. Page 63. — 1. $\frac{4}{5}$ ¢. 2. $47\frac{1}{2}$. 3. $18\frac{1}{2}$ lb. 4. 9 ft. $7\frac{1}{2}$; 2; 3; 1. 6. $\frac{3}{5}$ sec. 7. $1\frac{3}{4}$ in.; $1\frac{7}{8}$ in.; $1\frac{7}{8}$ in.; $2\frac{1}{8}$ in.; $3\frac{5}{8}$ in.; $7\frac{1}{2}$ lb.; $6\frac{1}{4}$ lb.; $7\frac{1}{2}$ lb.; $\frac{3}{4}$ lb.; $13\frac{3}{4}$ lb. 8. $4\frac{3}{4}$ ft. Page 64. — Addition: Test 1. $\frac{1}{4}$; $\frac{1}{2}$; $\frac{3}{8}$; $\frac{2}{5}$. Test 2. $\frac{2}{3}$; $\frac{5}{6}$; $\frac{2}{3}$. Test 3. $1\frac{1}{6}$; $1\frac{1}{2}$; $1\frac{1}{4}$; $1\frac{1}{3}$. Test 4. $1\frac{7}{15}$; $1\frac{5}{18}$; $1\frac{7}{20}$; $1\frac{4}{10}$. Test 5. $\frac{7}{24}$; $\frac{1}{24}$; $\frac{7}{20}$. Test 6. $3\frac{1}{3}$; $6\frac{1}{2}$; $5\frac{1}{5}$; $4\frac{1}{3}$. Subtraction: Test 1. 0; $\frac{1}{4}$; $\frac{2}{3}$; $\frac{1}{6}$. Test 2. $\frac{7}{20}$; $\frac{1}{15}$; $\frac{1}{20}$. Test 3. $\frac{1}{3}$; $\frac{1}{5}$; $\frac{1}{2}$; $\frac{1}{6}$. Test 4. $\frac{3}{20}$; $\frac{1}{12}$; $\frac{5}{24}$; $\frac{1}{6}$. Test 5. $4\frac{1}{2}$; $5\frac{1}{8}$; $4\frac{1}{4}$. Test 6. $6\frac{1}{2}$; $3\frac{3}{8}$; $3\frac{7}{8}$; $4\frac{5}{8}$. Page 65. — 1. 25¢. 2. \$1.80. 3. 4. 4. $6\frac{1}{2}$. 5. 8.15 A.M.; $2\frac{1}{2}$ hr. 6. 1 lb. 7. $90\frac{1}{2}$. Page 66. — 1. a. 1; b. 2; c. 3; d. 4; 2. a. $\frac{2}{3}$; b. $\frac{3}{5}$; c. $\frac{5}{6}$; d. $\frac{3}{8}$; e. $\frac{5}{12}$. 3. a. $1\frac{1}{3}$; b. $1\frac{1}{5}$; c. $\frac{6}{7}$; d. $\frac{8}{9}$; e. $\frac{9}{16}$. 4. a. $\frac{3}{4}$; b. $\frac{1}{3}$; c. $\frac{1}{3}$; d. $1\frac{1}{2}$; e. $1\frac{1}{4}$. 5. a. $\frac{1}{2}$; b. 2; c. $1\frac{1}{2}$; d. $2\frac{1}{2}$; e. $\frac{3}{5}$. 6. a. 5; b. 3; c. 3; $\frac{1}{2}$; e. $1\frac{1}{2}$. 7. a. $1\frac{1}{2}$; b. $2\frac{1}{2}$; c. $2\frac{1}{3}$; d. 3; e. 7. 8. a. $3\frac{1}{2}$; b. $2\frac{1}{2}$; c. $2\frac{1}{2}$; d. $\frac{1}{2}$; e. $1\frac{1}{2}$. Page 67. — 1. a. $3\frac{1}{3}$; b. $1\frac{1}{3}$; c. $7\frac{1}{2}$; d. $4\frac{1}{6}$; e. $\frac{4}{5}$. 2. a. $2\frac{4}{5}$; b. $4\frac{2}{3}$; c. $3\frac{1}{3}$; d. $8\frac{1}{4}$; $\frac{7}{8}$. 3. a. $3\frac{3}{4}$; b. $3\frac{3}{4}$; c. $5\frac{1}{4}$; d. $1\frac{1}{5}$; e. $4\frac{1}{5}$. 4. a. $7\frac{1}{2}$; b. $8\frac{2}{5}$; c. $2\frac{1}{4}$; d. $5\frac{1}{4}$; e. 9. a. $4\frac{1}{2}$; b. $13\frac{1}{2}$; c. $6\frac{2}{3}$; d. $9\frac{1}{3}$; e. $1\frac{1}{7}$. 6. a. $11\frac{1}{5}$; b. $14\frac{2}{5}$; c. $13\frac{1}{2}$; d. $11\frac{1}{4}$; e. $8\frac{1}{3}$. a. $7\frac{1}{2}$; b. $17\frac{1}{2}$; c. $1\frac{1}{3}$; d. $7\frac{1}{2}$; e. $10\frac{1}{2}$. 5. a. $12\frac{1}{2}$; b. $13\frac{1}{2}$; c. $16\frac{1}{2}$; d. $22\frac{1}{2}$; e. $17\frac{1}{2}$.

9. $a. 7\frac{1}{2}$; $b. 22\frac{1}{2}$; $c. 18\frac{2}{3}$; $d. 12\frac{1}{2}$; $e. 7\frac{1}{2}$. 1. 1 hr.; \$3. 2. $3\frac{3}{4}$. 3. 5; \$10. 4. 10; \$32. 5. $4\frac{1}{2}$; 9; 6; $6\frac{3}{4}$. 6. 75¢. Page 68.—7. 3. 8. $3\frac{1}{2}$. 9. 40¢; 48¢; 44¢; 60¢. 1. $a. 3$; $b. 4$; $c. 5$; $d. 6$; $e. 7$. 2. $a. 5$; $b. 7\frac{1}{2}$; $c. 10$; $d. 12\frac{1}{2}$; $e. 15$. 3. $a. 4\frac{1}{5}$; $b. 4\frac{8}{9}$; $c. 7$; $d. 9\frac{2}{3}$; $e. 8\frac{8}{9}$. 4. $a. 6\frac{1}{4}$; $b. 6\frac{2}{3}$; $c. 9\frac{1}{2}$; $d. 5\frac{1}{2}$; $e. 8\frac{3}{4}$. 5. $a. 9\frac{1}{2}$; $b. 11\frac{1}{2}$; $c. 21\frac{2}{3}$; $d. 15\frac{1}{2}$; $e. 26\frac{1}{2}$. 6. $a. 11\frac{1}{3}$; $b. 21\frac{3}{4}$; $c. 23\frac{1}{4}$; $d. 19\frac{1}{3}$; $e. 43\frac{1}{2}$. Page 69.—7. 15; $7\frac{1}{2}$; $11\frac{1}{4}$. 8. $62\frac{1}{3}$ ft. 9. $16\frac{1}{2}$. 10. 5280. Page 70.—9. $6\frac{2}{3}$; $7\frac{1}{2}$; $3\frac{1}{3}$; $4\frac{1}{6}$; $4\frac{2}{3}$; $2\frac{1}{4}$; $3\frac{1}{8}$; $5\frac{5}{8}$; $3\frac{3}{4}$; $10\frac{1}{2}$; $4\frac{1}{2}$; $17\frac{1}{2}$; $22\frac{1}{2}$; $14\frac{2}{3}$. 11. $2\frac{2}{3}$; $3\frac{1}{3}$; $6\frac{3}{4}$; $5\frac{1}{4}$; $8\frac{1}{4}$; $5\frac{5}{8}$; $4\frac{1}{3}$. 12. $11\frac{1}{4}$; $15\frac{3}{4}$; $16\frac{2}{3}$; $18\frac{2}{3}$; $19\frac{1}{5}$; $6\frac{3}{10}$; $18\frac{9}{10}$. 1. $\frac{1}{4}$; 3. 2. $\frac{1}{2}$ lb. 3. $4\frac{1}{2}$ yd. 4. $3\frac{1}{2}$. 5. $15\frac{1}{2}$. 6. $1\frac{3}{4}$ in.; $5\frac{1}{4}$ in. 7. $2\frac{1}{4}$ in. Page 71.—8. 35¢; 32¢. 9. 20¢; 60¢. 10. 9¢; 27¢. 11. 30¢; 50¢. 12. 27¢; 24¢. 13. 50¢; \$1.50. 14. 30¢. 15. $\frac{3}{4}$. Page 72.—2. $a. \frac{1}{3}$; $b. \frac{1}{4}$; $c. \frac{1}{5}$; $d. \frac{1}{5}$; $e. \frac{1}{8}$. 3. $a. 2$; $b. 2$; $c. 3$; $d. 2$; $e. 2$. 4. $a. \frac{2}{5}$; $b. \frac{3}{8}$; $c. \frac{3}{7}$; $d. \frac{7}{9}$; $e. \frac{3}{7}$. 5. $a. \frac{1}{2}$; $b. \frac{1}{3}$; $c. \frac{1}{3}$; $d. \frac{1}{5}$; $e. \frac{1}{4}$. 6. $a. \frac{3}{4}$; $b. \frac{2}{5}$; $c. \frac{2}{3}$; $d. \frac{2}{3}$; $e. \frac{2}{5}$. 7. $a. 1\frac{1}{2}$; $b. 1\frac{1}{3}$; $c. 1\frac{1}{2}$; $d. 1\frac{1}{2}$; $e. 1\frac{2}{3}$. 8. $a. 1\frac{1}{3}$; $b. 3\frac{1}{3}$; $c. 2\frac{2}{3}$; $d. 3\frac{3}{4}$; $e. 1\frac{7}{8}$. 9. $a. \frac{4}{15}$; $b. \frac{9}{20}$; $c. \frac{8}{15}$; $d. 2\frac{1}{12}$; $e. \frac{7}{20}$. 10. $a. \frac{8}{15}$; $b. 2\frac{2}{9}$; $c. 1\frac{1}{4}$; $d. 1\frac{1}{5}$; $e. \frac{5}{6}$. 11. $a. \frac{1}{6}$; $b. \frac{1}{12}$; $c. \frac{1}{10}$; $d. \frac{1}{15}$; $e. \frac{3}{20}$. 12. $a. \frac{4}{15}$; $b. \frac{3}{10}$; $c. 1\frac{7}{8}$; $d. 1\frac{1}{5}$; $e. \frac{9}{20}$. 13. $a. \frac{5}{6}$; $b. 2$; $c. 1\frac{1}{4}$; $d. 2\frac{2}{3}$; $e. 4$. 14. $a. \frac{8}{9}$; $b. 1\frac{1}{3}$; $c. \frac{3}{4}$; $d. 1\frac{2}{3}$; $e. 13\frac{1}{8}$. 15. $a. 1$; $b. 6$; $c. 10$; $d. 12\frac{1}{2}$; $e. 5\frac{5}{7}$. 1. 18¢. 2. $1\frac{1}{2}$ ft. 3. $2\frac{3}{4}$; $4\frac{1}{8}$; $4\frac{7}{2}$. 4. 100 ft. 5. \$15. Page 73.—6. 50 mi. 7. \$1.25; \$1.75; \$1.12 $\frac{1}{2}$. 8. 90¢. 9. 25 mi. 10. $5\frac{1}{4}$; $\frac{1}{4}$ yd. 11. 72¢. 12. 90. 13. Yes; $\frac{1}{4}$ yd. rem. 14. \$4.05; \$6.75. 15. \$2.75; \$1.92 $\frac{1}{2}$. Page 74.—1. $a. 1$; $b. 1$; $c. \frac{4}{5}$; $d. 1\frac{5}{9}$; $e. 1\frac{1}{6}$. 2. $a. 1\frac{1}{3}$; $b. 2$; $c. 6$; $d. 7\frac{1}{2}$; $e. 7\frac{1}{2}$. 3. $a. 9\frac{3}{8}$; $b. 10\frac{1}{2}$; $c. 7\frac{1}{2}$; $d. 15\frac{1}{8}$; $e. 31\frac{2}{3}$. 4. $a. 20$; $b. 28\frac{1}{3}$; $c. 22\frac{9}{16}$; $d. 56\frac{1}{4}$; $e. 50$. 1. $a. 300$; $b. 456$; $c. 1140$; $d. 2569$; $e. 1905$. 2. $a. 778\frac{2}{3}$; $b. 1120$; $c. 1651\frac{1}{5}$; $d. 2912\frac{1}{2}$; $e. 4209$. 3. $a. 442\frac{1}{18}$; $b. 1704\frac{5}{8}$; $c. 2750$; $d. 2754\frac{3}{8}$; $e. 2100\frac{8}{9}$. 4. $a. 3152\frac{1}{2}$; $b. 3106\frac{8}{9}$; $c. 5150\frac{1}{4}$; $d. 4383\frac{1}{3}$; $e. 6488\frac{5}{12}$. Page 75.—1. $a. \frac{1}{3}$; $b. \frac{1}{5}$; $c. \frac{3}{5}$; $d. \frac{1}{8}$; $e. \frac{2}{5}$. 2. $a. \frac{2}{3}$; $b. 1\frac{1}{2}$; $c. \frac{2}{3}$; $d. \frac{3}{10}$; $e. \frac{3}{10}$. 3. $a. \frac{1}{4}$; $b. \frac{1}{6}$; $c. \frac{1}{8}$; $d. \frac{1}{10}$; $e. \frac{1}{12}$. 4. $a. \frac{2}{9}$; $b. \frac{1}{6}$; $c. \frac{1}{10}$; $d. \frac{5}{8}$; $e. \frac{4}{9}$. 5. $a. \frac{8}{20}$; $b. \frac{5}{18}$; $c. \frac{1}{4}$; $d. \frac{1}{15}$; $e. \frac{3}{20}$. 7. $a. \frac{4}{15}$; $b. \frac{2}{9}$; $c. \frac{1}{16}$; $d. \frac{3}{20}$; $e. \frac{1}{14}$. 8. $a. \frac{5}{12}$; $b. \frac{1}{12}$; $c. \frac{1}{12}$; $d. \frac{3}{8}$; $e. \frac{3}{8}$. 9. $2\frac{1}{5}$. 10. $a. 3\frac{8}{16}$; $b. 2\frac{9}{16}$; $c. 5\frac{1}{4}$; $d. 9\frac{3}{8}$; $e. 4\frac{9}{16}$. 11. $a. \frac{1}{8}$; $b. 1\frac{1}{3}$; $c. 1\frac{1}{2}$; $d. 1\frac{2}{3}$; $e. 3\frac{1}{8}$. Page 77.—1. 3; $4\frac{1}{2}$; $2\frac{2}{3}$; $3\frac{3}{4}$; $2\frac{3}{5}$; 2. $7\frac{1}{2}$; $3\frac{1}{3}$; $4\frac{2}{3}$; $3\frac{1}{5}$; $13\frac{1}{2}$; $16\frac{2}{3}$. 3. $10\frac{2}{3}$; $2\frac{3}{5}$; $7\frac{1}{5}$; 8; 6; 9. 4. $10\frac{1}{2}$; 4; 25; $13\frac{1}{2}$; $5\frac{1}{3}$; $13\frac{1}{3}$. Page 78.—1. $a. \frac{1}{2}$; $b. \frac{5}{6}$; $c. 1\frac{1}{2}$; $d. 3\frac{5}{8}$; $e. \frac{1}{2}$; $f. 1\frac{1}{5}$. 2. $a. \frac{4}{9}$; $b. \frac{3}{4}$; $c. 4\frac{1}{2}$; $d. \frac{5}{9}$; $e. 2\frac{1}{4}$; $f. \frac{6}{7}$. Page 79.—1. $a. 2$; $b. \frac{2}{3}$; $c. 1\frac{2}{3}$; $d. \frac{1}{2}$. 2. $a. 2$; $b. \frac{1}{3}$; $c. \frac{5}{8}$; $d. 6$. 3. $a. 1\frac{1}{3}$; $b. 1\frac{1}{6}$; $c. \frac{2}{3}$; $d. 1\frac{1}{6}$. 4. $a. \frac{1}{2}$; $b. 2\frac{1}{3}$; $c. \frac{1}{10}$; $d. 1\frac{1}{2}$. 5. $a. 1\frac{1}{10}$; $b. \frac{5}{9}$; $c. 1\frac{1}{2}$; $d. \frac{3}{4}$. 6. $a. 2\frac{2}{3}$; $b. 1\frac{1}{6}$; $c. 1\frac{3}{4}$; $d. \frac{4}{5}$. 7. $a. \frac{1}{2}$; $b. \frac{3}{4}$; $c. 2\frac{5}{8}$; $d. 8$. 8. $a. 1\frac{1}{6}$; $b. \frac{5}{14}$; $c. \frac{1}{6}$; $d. 5\frac{1}{4}$. 9. $a. 3$; $b. 5$; $c. 5$; $d. 10$. 10. $a. 9$; $b. 5\frac{1}{2}$; $c. 10$; $d. 10$. 11. $a. 15$; $b. 8\frac{2}{3}$; $c. 25$; $d. 12\frac{1}{2}$. 12. $a. 26$; $b. 16\frac{2}{3}$; $c. 25$; $d. 25$. 13. $a. \frac{1}{3}$; $b. 5$; $c. 4$; $d. \frac{1}{2}$. 14. $a. 3$; $b. \frac{1}{5}$; $c. \frac{1}{5}$; $d. 2$. 15. $a. 2$; $b. 2$; $c. \frac{1}{3}$; $d. \frac{1}{2}$. 16. $a. 2$; $b. 3$; $c. \frac{1}{2}$; $d. 3$. 17. $a. \frac{2}{3}$; $b. 15$; $c. 5$; $d. 1\frac{1}{2}$. 18. $a. \frac{1}{3}$; $b. \frac{1}{15}$; $c. 5$; $d. 1\frac{2}{3}$. 19. $a. 3$; $b. 1\frac{2}{3}$; $c. \frac{1}{5}$; $d. \frac{5}{7}$. 20. $a. \frac{1}{2}$; $b. 2$; $c. \frac{1}{4}$; $d. \frac{1}{2}$. Page 80.—1. 10. 2. 3. $4\frac{8}{13}$ in. 4. 24. 5. 2; 4; 4; 8. 6. 15. 7. 2. 8. 22. 9. 30¢. 10. 8. 11. 8. 12. $\frac{7}{8}$. 13. 32¢. 14. 24 bu. Page 82.—3. 20¢; $26\frac{2}{3}$ ¢; 40¢; 50¢. 4. $\frac{1}{3}$; $\frac{2}{3}$. 5. $\frac{1}{3}$; $\frac{2}{3}$. 6. 4; 8. 7. 25¢; 50¢. Test 1. $\frac{2}{3}$; $\frac{3}{4}$; $\frac{7}{8}$; $\frac{2}{3}$. Test 2. $\frac{1}{2}$; $\frac{1}{2}$; $\frac{3}{4}$; $\frac{2}{3}$. Test 3. $1\frac{1}{8}$; $1\frac{1}{3}$; $1\frac{1}{5}$; $1\frac{1}{2}$. Test 4. $1\frac{1}{12}$; $1\frac{1}{18}$; $1\frac{1}{15}$;

1. 1 ft. 8 in.; 2 ft. 3 in.; 2 ft. 6 in.; 3 ft. 4 in. 12. 207.36. 13. 16.5.
 Page 127.—2. Draw each line four times as long as the corresponding one on the map. 3. Draw each line two times as long as the corresponding one on the map and the distance between the plats twice as great. 4. 24. 5. 72. 6. 72. 7. 144. 8. 8. 9. 6. 10. \$12.56; \$20.72. Page 128.—2. 1; 4; 9; 16. 3. Compare with answers to example 1. 4. 25; 36; 100; 144. 7. $30\frac{1}{4}$.
 Page 129.—9. $4; 25; 100; \frac{1}{4}$. 10. $4; 9; 100; 6\frac{1}{4}$. 11. Multiply the number by itself. 2. 6; 3 and 2. 3. 1 sq. in. 4. 6; 3 and 2. 5. 1 sq. ft. 6. 3 in. and 3 in.; 3 ft. and 2 ft. Page 130.—7. 1 sq. in.; 1 sq. ft.; 1 sq. yd. 8. 5 and 5; 6 and 3; 4 and 3; 6 and $1\frac{1}{2}$. 1. a. 24 sq. in., 20 sq. in.; b. 12 sq. in., 15 sq. in.; 8 sq. in., 35 sq. in.; 80 sq. in., 70 sq. in. 2. 10. 3. 320. 5. 288; 288; 72. 6. 10. 7. $40; \frac{1}{4}$. Page 131.—8. 4840. 9. 1 A. 10. 16. 4. 8. 5. 27. 6. 64. 7. 1 cu. in. Page 132.—8. See answers to examples 4, 5, and 6. 9. 12; 12; 2; 1728. 10. 3; 3; 3; 27. 11. 24. Page 133.—14. 8000. 15. 231. 16. 3. 17. 192. 1. 1 lb. 8 oz.; 1 lb. 10 oz.; 1 lb. 14 oz.; 2 lb. 3 oz.; 1 lb. 12 oz.; 1 lb. 15 oz.; 1 lb. 15 oz. 2. 1 ft.; 1 ft. 11 in.; 2 ft. 4 in.; 2 ft. 4 in.; 1 ft. 9 in.; 2 ft. 3 in.; 2 ft. 5 in. 3. 5 lb. 3 oz.
 Page 134.—4. 14 lb. 2 oz. 5. 10 ft. 11 in. 6. 13 gal. 2 qt. 7. 9 bu. 2 pk. 3 lb. 12 oz. 2. 7 lb. 8 oz. 3. 5 bu. 1 pk. 4. 4 hr. 15 min. 5. 8 ft. 3 in. 2 hr. 30 min. 7. 5 lb. 8 oz. 8. 2 ft. 4 in. 9. 3 lb. 8 oz. 10. 1 hr. 25 min.
 Page 135.—11. 6 in.; 1 ft. 4 in. 12. \$2.20. 1. 1 ft. 2. 14 gal. 3. 27 bu. 42 ft. 5. 26 lb. 6. 13 lb. 12 oz. Page 136.—7. 21 gal. 8. 23 bu. 3 pk. 44 ft. 4 in. 10. 33 lb. 12 oz. 1. 3 lb. 6 oz. 2. 3 gal. 1 qt. 3. 2 ft. 10 in. 3 lb. 15 oz. 5. 1 hr. 45 min. 6. 2 bu. 2 pk. 7. 2 ft. 5 in. 8. 3 hr. 16 min. 3 lb. 5 oz. 10. 28 in. 12. 4 ft. 11.2 in. Page 137.—4. See page 7. 6. See page 18. 8. See page 25. 12. See page 33. 13. The sums: $\frac{3}{4}; 6; 4\frac{1}{2}; 6; \frac{1}{4}; .9; .75; .16; .33; 1$ ft. The differences $\frac{1}{2}; 1; \frac{1}{6}; 3\frac{1}{2}; 1\frac{1}{4}; .5; .15; .08; .27; 2$ in.
 Page 138.—14. The sums: 5 ft.; 24 hr.; 4 gal. 1 qt.; 4 lb.; 4 hr. The differences: 2 ft. 8 in.; 12 hr.; 1 gal. 1 qt.; 1 lb.; 1 hr. 20 min. 15. The sums: 9¢; \$1; $1\frac{1}{8}$ lb.; 2.25 oz.; \$1; \$1; \$1.50. The differences: 25¢; $33\frac{1}{3}$ ¢; $\frac{5}{8}$ lb.; 25 oz.; 75¢; 50¢; \$1.25. 21. 1. 22. $\frac{3}{2}; 2; \frac{1}{5}; 5$. 23. $\frac{3}{8}; 5; 10; .4; 1; .07; \frac{6}{7}; 5$; 25; 50; 100. 24. $\frac{2}{9}; \frac{2}{9}; 3; .06; 4; 16; 1\frac{1}{3}; 4; 1\frac{1}{4}; 2; 2; \frac{1}{2}; \frac{3}{4}; 1\frac{1}{3}; 2; \frac{1}{2}; .01; \0.08 .
 Page 139.—25. The sums: $\frac{1}{3}; \frac{4}{5}; \frac{5}{8}; 1\frac{1}{6}; 1\frac{2}{3}; 1\frac{7}{4}; \frac{3}{16}; 8\frac{3}{8}$. The differences: $\frac{1}{6}; \frac{1}{8}; \frac{2}{3}; \frac{1}{6}; \frac{1}{24}; \frac{1}{36}; \frac{5}{8}$. 26. $\frac{1}{8}; \frac{2}{15}; \frac{3}{8}; \frac{1}{15}; \frac{2}{5}; \frac{5}{7}; \frac{1}{15}; 1\frac{1}{2}; 10; 6\frac{1}{4}; .12; .012$. 27. $1\frac{1}{2}; \frac{8}{15}; \frac{4}{5}; 1\frac{1}{6}; \frac{6}{7}; 1\frac{1}{2}; \frac{3}{16}; 1\frac{1}{4}; 1\frac{1}{2}; \frac{2}{3}; 2\frac{1}{2}; \frac{1}{2}$. 28. Dividing by $\frac{5}{2}; 2; 2\frac{2}{5}; 4; 4\frac{4}{5}; 6; 10; 20$. Dividing by $\frac{5}{4}; 4; 4\frac{4}{5}; 6\frac{2}{5}; 8; 9\frac{3}{5}; 12; 20; 40$. 29–32. See principle foot of page 77; see also example 8, page 94. 33. Yes; multiply each number by .4, then each by .8. 34. 2367. 35. 170. 36. 21. 37. See page 33. 38. 10; 56; 1000. 39. $1\frac{1}{2}$ hr.; $1\frac{1}{4}$ hr.; $\frac{3}{4}$ hr.; $1\frac{2}{3}$ hr. 40. $8\frac{1}{3}$.
 Page 140.—41. 1776. 42. 64. 43. \$21.60. 44. \$5. 45. 15¢. 46. \$2.40. 47. 75. 48. 60 mi.; 570 mi. 49. 32¢; 19.2¢. 50. \$2.25. 51. 660. 52. 10.5.
 Page 141.—53. 7¢; 6.5¢; 5.9¢. 54. 14¢. 55. \$500. 56. 219,342; \$15,199.25.

57. 60¢. 58. \$1339. 59. 153.6. 60. $\frac{1}{6}$. 61. 32 sq. ft. 62. \$13.50. Page 142.—
 63. 4; \$1; 17¢. 64. 5 in.; 1 ft. 3 in.; 10 in. 65. $1\frac{1}{3}$ ¢; \$8.40. 66. 15¢. 67. 19.5¢.
 68. 6 ft. 6 in.; 8 ft.; 7 ft. 69. 2; 20 gal. 70. 28.47, nearly. Page 143.—71.
 \$357.65. 72. \$6.78. 73. 5; 13; 19; 22; 33; 49. 74. \$45; \$15.95; \$5.85. 75. 307.5.
 Page 148.—1. 5550. 2. 5828. 3. 4687. 4. 4668. 5. 4688. 6. 4687.
 Page 149.—7. 5084. 8. 4558. 9. 4830. 10. 3328. 11. 4175. 12. 4049. 13.
 \$1998.09. 14. \$1857.05. 15. \$1819.99. 16. \$2148.25. 17. \$1722.89. 18. \$3284.20.
 Page 150.—2. 79,487,529. 3. 64,988,905. 4. 85,592,661. 5. 763,779,-
 210. 6. 99,007,866. 7. 81,523,414. 8. 140,543,261. 9. 37,013,841. 10. 73,-
 520,483. 11. 2,895,274. 12. 161,205,963. 13. 373,486,250. 14. \$2089.50.
 15. \$5174.50. 16. \$39,988.75. 17. \$6214.50. Page 151.—2. a. 214,455;
 b. 425,208; c. 264,846; d. 480,819; e. 118,464; f. 245,076; g. 482,334; h. 308,864.
 3. a. 185,934; b. 616,395; c. 409,101; d. 106,596; e. 332,108; f. 96,300; g. 484,200;
 h. 682,064. 4. 677,856; 854,688; 503,480; 2,401,968; 1,986,904. 5. 1,045,764;
 1,318,572; 776,745; 3,705,642; 3,065,301. 6. 2,190,060; 2,761,380; 1,626,675;
 7,760,430; 6,419,415. 7. 2,385,192; 3,007,416; 1,771,610; 8,451,876; 6,991,378.
 8. 1,568,784; 1,978,032; 1,165,220; 5,558,952; 4,598,356. 9. 2,694,588; 3,397,-
 524; 2,001,415; 9,548,214; 7,898,267. 10. 2,210,484; 2,787,132; 1,641,845;
 7,832,802; 6,479,281. 11. 1,947,456; 2,455,488; 1,446,480; 6,900,768; 5,708,304.
 Page 152.—7. 205. 8. 409. 9. 802. 10. 405. 11. 271. 12. 506. 13. 629, rem.
 39; 242, rem. 158; 180, rem. 294. 24. 6540, rem. 125; 4254, rem. 161; 2540, rem.
 185; 1203, rem. 701; 896, rem. 197. 25. 6722, rem. 16; 4372, rem. 132; 2610,
 rem. 314; 1237, rem. 228; 921, rem. 26. 26. 6123, rem. 101; 3983, rem. 85; 2378,
 rem. 173; 1127, rem. 127; 839, rem. 41. 27. 5559, rem. 94; 3616, rem. 104; 2159,
 rem. 145; 1023, rem. 256; 761, rem. 742. 28. 2281, rem. 95; 1084, rem. 169; 1559,
 rem. 467; 948, rem. 585; 790, rem. 111. 29. 2508, rem. 64; 1192, rem. 56; 1715,
 rem. 42; 1043, rem. 56; 868, rem. 700. 30. 2024, rem. 164; 962, rem. 132; 1384,
 rem. 164; 841, rem. 756; 701, rem. 169. 31. 2312, rem. 48; 1098, rem. 656;
 1581, rem. 14; 961, rem. 448; 800, rem. 800. 32. 2601, rem. 54; 1236, rem. 192;
 1778, rem. 332; 1081, rem. 608; 900, rem. 900. Page 154.—5. 1, 2, 3,
 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47. 7. 4, 6, 8, 9, 10, 12, 14,
 15, 16, 18, 20, 21, 22, 24, 25, 26, 27, 28, 30, 32, 33, 34, 35, 36, 38, 39.
 Page 155.—2. 3, 9; 2, 3, 6; 2, 3, 6; 7; 2, 7, 14; 2, 4, 8; 2, 3, 4, 6, 12; 2, 5,
 10; 2, 4, 8, 16; 2, 3, 4, 6, 12; 2, 5, 10; 2, 4, 5, 10, 20; 2, 4, 8; 2, 3, 6; 2, 3, 6, 12.
 Page 156.—1. 15. 2. 21. 3. 20. 4. 24. 5. 9. 6. 6. 7. 5. 8. 12.
 9. 14. 10. 18. 11. 10. 12. 10. 13. 3. 14. 6. 15. 3. 16. 4. 17. 1. 18. 1.
 19. 4. 20. 18. 21. 168. 22. 3. 23. 30. 24. 10. Page 157.—25. 60. 26.
 135; $5\frac{5}{8}$. 27. 5. 2. 50. 3. 200. Page 158.—4. \$6. 5. \$10.65. 6. 63 in.
 7. 630. 8. 2773. 9. The former by \$16. 10. \$2225; 4. 11. 13,737,954. 12. 300.
 Page 159.—13. \$320; $\$26\frac{2}{3}$. 14. $2\frac{1}{6}$ mi. 15. \$12.48. 16. 5280; 63,360.

7. More by 200 lb. 18. 150. 19. \$30. 20. \$580.80. 21. 102,040; 160. 22. \$1544.

Page 161. — 1. $a. \frac{1}{2}$; $b. 1\frac{1}{2}$; $c. \frac{9}{16}$; $d. 1\frac{1}{10}$; $e. \frac{3}{4}$; $f. 1\frac{1}{4}$; $g. \frac{3}{40}$; $h. 1\frac{7}{40}$; $i. \frac{19}{24}$; $j. \frac{17}{24}$; $k. \frac{23}{60}$; $l. 1\frac{8}{15}$. 2. $a. 5\frac{3}{5}$; $4\frac{2}{5}$; $b. 6, 5\frac{5}{8}$; $c. 3\frac{1}{2}, 5\frac{17}{20}$; $d. 6\frac{2}{9}, 8\frac{19}{90}$; $e. 6\frac{1}{4}, 3\frac{7}{8}$; $6\frac{8}{9}, 10\frac{8}{45}$; $g. 6\frac{3}{8}, 2\frac{1}{6}$; $h. 3\frac{1}{2}, 4\frac{1}{5}$. Page 162. — 1. $a. \frac{7}{8}, 8$; $b. 1\frac{1}{8}, 13\frac{3}{8}$; $c. 1\frac{1}{4}, 1\frac{1}{2}$; $d. 7\frac{1}{2}, 11\frac{1}{6}$; $e. 1\frac{1}{8}, 11$; $f. 2\frac{1}{4}; 1\frac{13}{8}$; $g. 11\frac{1}{4}, 1$; $h. 12\frac{5}{8}, 6\frac{6}{7}$. 2. $a. \frac{1}{5}$; $b. \frac{3}{4}$; $c. \frac{5}{8}$; $d. \frac{1}{2}$; $e. \frac{2}{5}$; $f. \frac{1}{5}$; $g. \frac{1}{2}$; $h. \frac{1}{20}$; $i. \frac{9}{20}$; $j. \frac{1}{6}$. 3. $a. 5\frac{2}{3}, 3\frac{1}{3}, \frac{1}{8}$; $b. 4\frac{1}{2}, 3\frac{1}{2}, 1\frac{3}{8}$; $c. 8\frac{1}{4}, 4\frac{3}{4}$; $d. 9\frac{1}{2}, 7\frac{7}{4}, 5\frac{1}{6}$; $e. 7\frac{3}{4}, 8\frac{1}{2}, 7\frac{5}{8}$; $f. 5\frac{1}{6}, 5\frac{1}{4}, 3\frac{4}{9}$; $g. 7\frac{1}{2}, 3\frac{1}{2}, 6\frac{1}{4}$; $h. 3\frac{1}{2}, 1\frac{1}{2}, 6\frac{1}{2}$. Page 163. — 2. $a. 1$; $b. \frac{1}{4}$; $c. 2$; $d. \frac{2}{3}$; $e. 2\frac{1}{3}$. 3. $a. \frac{8}{9}$; $b. \frac{3}{4}$; $c. 2\frac{1}{2}$; $d. 20$; $e. 12\frac{1}{2}$. 4. $a. \frac{8}{10}$; $b. \frac{2}{3}$; $c. \frac{3}{5}$; $d. \frac{4}{9}$; $e. \frac{9}{10}$. 5. $a. 1\frac{7}{8}$; $b. 2\frac{1}{2}$; $c. 10\frac{1}{2}$; $d. 11$; $e. 20$. 6. $a. 20$; $b. 11\frac{1}{2}$; $c. 3\frac{3}{5}$; $d. 1\frac{1}{9}$; $e. 1\frac{1}{9}$. 7. $a. 1\frac{1}{3}$; $b. 10\frac{1}{2}$; $c. 10$; $d. 9\frac{5}{8}$; $e. 15$. 8. $a. 2\frac{1}{4}$; $b. 6\frac{1}{4}$; $c. 8\frac{8}{9}$; $d. 28\frac{1}{8}$; $e. 8\frac{1}{3}$. 9. $a. 6\frac{1}{4}$; $b. 6\frac{1}{4}$; $c. 11$; $d. 3\frac{1}{8}$; $e. 1$. 10. $a. 1$; $b. 1\frac{3}{7}$; $c. 2$; $d. 1$; $e. \frac{1}{2}$. 11. $a. 600$; $b. 315$; $c. 299\frac{1}{4}$; $d. 295$; $e. 438\frac{3}{4}$. 12. $a. 305$; $b. 394\frac{1}{10}$; $c. 301$; $d. 609\frac{3}{8}$; $e. 614\frac{1}{4}$. 13. $a. 409\frac{1}{20}$; $b. 947\frac{3}{5}$; $c. 411\frac{1}{9}$; $d. 1194\frac{3}{8}$; $e. 3581\frac{4}{5}$. 14. $a. 2222\frac{2}{9}$; $b. 2839\frac{1}{16}$; $c. 1914\frac{2}{7}$; $d. 1093\frac{3}{4}$; $e. 2608\frac{1}{14}$. 15. $a. 2055\frac{5}{9}$; $b. 421\frac{7}{10}$; $c. 1865\frac{1}{2}$; $d. 3478\frac{1}{2}$; $e. 3293\frac{1}{10}$. 16. $a. 2072\frac{1}{10}$; $b. 156\frac{1}{4}$; $c. 277\frac{7}{9}$; $d. 310\frac{7}{9}$; $e. 807\frac{1}{2}$. 17. $\frac{1}{2}$. 18. $\frac{1}{45}$. 19. $\frac{7}{25}$. 20. $\frac{1}{7}$. 21. 3. 22. $\frac{1}{2}$. 23. 1. 24. 6.

Page 164. — 5. $a. 2\frac{1}{2}$; $b. 1\frac{1}{3}$; $c. \frac{2}{3}$; $d. 1\frac{1}{4}$; $e. 4$. 6. $a. \frac{5}{6}$; $b. 2\frac{1}{3}$; $c. \frac{3}{4}$; $d. 1\frac{1}{5}$; $e. \frac{7}{25}$. 7. $a. 1\frac{1}{2}$; $b. \frac{2}{3}$; $c. 1\frac{7}{10}$; $d. \frac{3}{5}$; $e. \frac{4}{5}$. 8. $a. \frac{1}{6}$; $b. 2\frac{1}{4}$; $c. \frac{1}{6}$; $d. 6$; $e. 3\frac{1}{3}$. 9. $a. 5$; $b. 5$; $c. 3$; $d. \frac{1}{3}$; $e. 8$. 10. $a. 3$; $b. \frac{1}{9}$; $c. \frac{3}{8}$; $d. \frac{1}{3}$; $e. 1\frac{1}{3}$. 11. $a. \frac{1}{2}$; $b. 4$; $c. 4$; $d. \frac{1}{3}$; $e. 1\frac{2}{3}$. Page 165. — 2. $a. 2\frac{2}{3}$; $b. 1\frac{1}{7}$; $c. 3$; $d. 1\frac{1}{2}$; $e. 1\frac{3}{5}$. 3. $a. 2$; $b. 1\frac{2}{5}$; $c. 7\frac{1}{8}$; $d. 8\frac{2}{3}$; $e. 6\frac{7}{8}$. 4. $a. 2\frac{1}{2}$; $b. 10$; $c. 8$; $d. 1\frac{7}{8}$; $e. 16\frac{2}{3}$. 4. Reading from left to right: $1\frac{1}{4}; \frac{3}{7}; \frac{4}{9}; \frac{3}{4}; 1\frac{1}{3}; \frac{1}{2}; \frac{1}{2}; 1\frac{1}{2}; \frac{2}{3}; \frac{5}{6}; \frac{4}{5}; \frac{3}{4}; 1\frac{1}{2}; \frac{2}{3}; \frac{7}{8}; \frac{7}{10}; 1\frac{1}{8}; \frac{4}{5}$. 5. $\frac{3}{5}$. 7. $\frac{4}{5}$. 8. $\frac{3}{4}; \frac{4}{3}$. 9. $\frac{1}{2}; \frac{1}{5}; \frac{2}{5}; \frac{7}{10}; \frac{9}{10}; \frac{4}{5}; \frac{3}{5}; \frac{1}{4}$. 10. $\frac{1}{6}; \frac{5}{6}; \frac{1}{3}; \frac{2}{3}; \frac{3}{2}; \frac{1}{4}; \frac{3}{4}$. 11. 2; 4; 20¢; 30¢; 40¢; 50¢. Page 166. — 1. $\frac{2}{3}$. 2. 4. 3. Yes. 4. 6. 5. 2; 8. 10; 15; 12. 7. 40¢. 8. 50. 9. \$6; $\frac{2}{5}$; \$2.40. 10. \$4.50. 11. 90. 12. $\frac{3}{8}$; \$8.

Page 167. — 1. $\frac{1}{8}$. 2. $2\frac{1}{4}$. 3. 4. 4. $\frac{1}{2}$. 5. $\frac{2}{5}$. 6. $\frac{3}{8}$. 7. $7\frac{1}{2}$. 8. $\frac{5}{8}$. 9. 4. 10. $\frac{3}{4}$. 11. $\frac{1}{5}$. 12. $\frac{3}{8}$. 13. $\frac{1}{16}$. 14. $\frac{1}{4}$. 15. $\frac{3}{7}$. 16. $\frac{1}{15}$. 17. $\frac{1}{3}$. 18. $\frac{5}{8}$. 19. $\frac{7}{8}$. 20. $\frac{1}{9}$. 21. $\frac{1}{12}$. 22. $\frac{1}{6}$. 23. $\frac{1}{7}$. 24. $\frac{2}{3}$. Page 168. — 1. 20¢. 2. $\frac{3}{8}$. 3. 70'; 35'; 42 $\frac{1}{2}$ '; 65'; 57 $\frac{1}{2}$ '. 4. See Rule for checking, page 18. 5. $1\frac{8}{9}$ ¢. 6. $\frac{5}{8}; \frac{1}{4}$. 7. The one having the greater numerator. 8. $\frac{5}{6}; \frac{5}{4}$. 9. The one having the less denominator. 10. \$1.20. 11. See pages 73 and 74. 12. 64. 13. See pages 78 and 164. 14. \$33.25. Page 169. — 15. 160. 16. 95¢. 17. $1\frac{5}{8}$ yd. 18. \$14.25. 19. 4 $\frac{1}{2}$. 20. See page 56. 21. $\frac{1}{32}$. 22. $\frac{1}{2}$ ". 23. See page 57. 24. 3". 25. 12 bu. 26. See page 59. 27. \$1.56. 28. 10.

Page 170. — 29. Draw a rectangle 3" by 1". 30. See page 50. 32. Yes. 33. No; see page 49. 34. No; see page 50. 35. \$6. 36. $3\frac{1}{3}$. 37. $95\frac{3}{4}$. 38. $\frac{1}{5}; \frac{2}{10}$. 39. 30¢; 15¢; 20¢; 10¢; 45¢. 40. $\frac{12\frac{1}{2}}{100}, \frac{37\frac{1}{2}}{100}$, etc.

Page 171. — 41. \$120; \$45. 42. 90 mi. 43. $\frac{9}{10}$. 44. $6\frac{1}{4}$; \$1.87 $\frac{1}{2}$. 45. 8. 46. \$1. 47. 6. 48. $3\frac{3}{4}$ in. 49. 3 ft. 50. $18\frac{3}{8}$. 51. 12. Page 175. — 1. In order from left to right: \$30; \$7; 80¢; 6¢. 2. More. 3. \$0.90. 4. \$37.90. 5. \$38. 6. \$38. 7. More. 8. \$0.53. 9. \$0.98. 10. \$0.50. 11. \$0.50. 12.

4.83; 4.8; 5. **13.** 3.142; 3.14; 3.1; 3. **14.** \$7.39. **Page 176.** — **6.** .01; .02; .006; .0007; .00008; .000009. **7.** .48; .65; .075; .0087; .00095; .000082. **8.** .275; .856; .0285; .4875; .08325; .009756. **9.** 2.75; 5.032; 9.575; 8.027; 10.0275; 25.003458. **10.** $.12\frac{1}{2}$; $.37\frac{1}{2}$; $.66\frac{2}{3}$; $.08\frac{1}{3}$; $.16\frac{2}{3}$; $.62\frac{1}{2}$. **11.** $.16\frac{2}{3}$; $.12\frac{1}{2}$; $.033\frac{1}{3}$. **12.** $.066\frac{2}{3}$; $.33\frac{1}{3}$; .0045. **Page 177.** — **13.** .416; .0007. **14.** *and*. **15.** 6000.-006. **9.** $\frac{9}{20}$; $\frac{3}{4}$; $\frac{7}{20}$; $\frac{13}{20}$; $\frac{3}{20}$. **10.** $\frac{1}{8}$; $\frac{3}{8}$; $\frac{7}{8}$; $\frac{3}{40}$; $\frac{9}{40}$. **11.** $\frac{1}{8}$; $\frac{1}{7}$; $\frac{3}{16}$; $\frac{3}{8}$; $\frac{7}{8}$. **12.** $\frac{5}{6}$; $\frac{1}{3}$; $\frac{5}{6}$; $\frac{2}{7}$; $\frac{5}{8}$. **13.** $\frac{1}{16}$; $\frac{3}{7}$; $\frac{7}{12}$; $\frac{1}{6}$; $\frac{1}{12}$. **14.** $\frac{1}{3}$; $\frac{1}{40}$; $\frac{1}{6}$; $\frac{5}{6}$; $\frac{2}{3}$. **Page 178.** — **1.** \$41.82. **2.** \$32.30. **3.** \$30.60. **4.** \$135.90. **5.** \$223.38. **6.** \$4.39. **7.** 2.28 ft. **8.** 6.15 lb. **9.** 5.24 mi. **10.** 1.68 sec. **11.** 3.801. **12.** 1.696. **13.** 6.911. **14.** 5.191. **15.** 7.625. **16.** \$1.25. **17.** \$4.23. **Page 179.** — **18.** 5.0219. **19.** 5.38673. **20.** 3.92406. **21.** 5.935181. **22.** .28875. **23.** .53256. **24.** .486688. **25.** .663092. **1.** \$3.45. **2.** \$1.35. **3.** \$2.10. **Page 180.** — **4.** 18.73 in. **5.** 9.4 ft. **6.** 1.75 in. **7.** .34 ft. **Page 181.** — **9.** *a.* .294; *b.* .0105; *c.* 1.26; *d.* .0168; *e.* .00075; *f.* 22.5. **10.** *a.* 3.24; *b.* .0216; *c.* 2.7; *d.* .432; *e.* .00216; *f.* .00378. **11.** *a.* \$17.875; *b.* \$9.50; *c.* \$2.065; *d.* \$6.375; *e.* \$0.5625; *f.* \$21.25. **12.** *a.* .6875 mi.; *b.* 73.625¢; *c.* \$4.725; *d.* 7.92 A.; *e.* 2.4 lb.; *f.* .365 in. **13.** *a.* .645 mi.; *b.* \$1.14; *c.* 3.945 ft.; *d.* .2523 ft.; *e.* 29.8452; *f.* .251328. **14.** 4; 5; 6. **15.** 488.125 lb. **16.** 486.75 lb. **17.** 15 lb. **18.** 849.875 lb. **Page 182.** — **1.** 27; 2.7; 27; 270; 27; 2.7. **2.** See page 101. **8.** 100. **9.** \$1. **10.** \$1.25. **11.** 30¢. **12.** \$1.40. **13.** \$1.75; \$17.50. **Page 183.** — **1.** \$0.875; \$7; \$8. **2.** \$60. **3.** \$70,400. **4.** \$3350. **5.** 12. **6.** \$5.50. **7.** 48¢. **8.** \$19,513.375. **9.** \$15. **10.** 25.65. **11.** \$11. **Page 184.** — **9.** *a.* .09; *b.* .005; *c.* .12; *d.* .0007; *e.* 1.35. **10.** *a.* .5; *b.* .1875; *c.* 1.08; *d.* .525; *e.* .0825. **11.** *a.* .775; *b.* .046; *c.* .57; *d.* .003; *e.* .51875. **12.** *a.* .07625; *b.* .052; *c.* .58; *d.* .0005; *e.* .007. **Page 185.** — **14.** *a.* .17; *b.* .42; *c.* .72; *d.* .47; *e.* .89; *f.* .86. **15.** *a.* .71; *b.* .44. *c.* 5.33; *d.* .78; *e.* .82; *f.* .14. **4.** *a.* 2; *b.* 2; *c.* 4; *d.* 2; *e.* 3. **5.** *a.* 3; *b.* 6; *c.* 4; *d.* 4; *e.* 8. **6.** *a.* 3; *b.* 8; *c.* 2; *d.* 3; *e.* 3. **Page 186.** — **8.** *a.* .9; *b.* 1.4; *c.* .07; *d.* .07; *e.* .09. **9.** *a.* .14; *b.* .06; *c.* 1.2; *d.* .8; *e.* 7. **10.** *a.* 25; *b.* 5; *c.* 250; *d.* 200. **11.** *a.* 200; *b.* 900; *c.* 900; *d.* 1.2; *e.* 11. **12.** *a.* 10; *b.* .1; *c.* .1; *d.* 100. **13.** *a.* 10; *b.* 100; *c.* 20; *d.* 200; *e.* 3000. **Page 187.** — **4.** *a.* 2.5; *b.* 25; *c.* .025; *d.* 2500. **5.** *a.* 12; *b.* .012; *c.* 1200; *d.* 12000. **6.** *a.* .8; *b.* .08; *c.* 80; *d.* 8000. **7.** *a.* 360; *b.* 3.6; *c.* 3.6; *d.* 3600. **8.** *a.* 4.2; *b.* .42; *c.* 4.2; *d.* 420. **9.** *a.* .36; *b.* .36; *c.* .036; *d.* 2.05. **10.** *a.* 20.5; *b.* .205; *c.* 205; *d.* .205. **1.** 18.2. **2.** 2¢. **3.** 3886.6. **4.** 40¢; 48¢; 38¢; 60¢. **Page 188.** — **5.** 1.2 T. **6.** $1\frac{1}{4}$ ¢. **7.** \$11.36. **8.** 3.73. **9.** 2 in.; 6.2 lb. **2.** *a.* .25; *b.* .75; *c.* .125; *d.* .625; *e.* .35; *f.* .28; *g.* .06. **3.** *a.* .075; *b.* .875; *c.* .1875; *d.* .5625; *e.* .9375; *f.* .0625; *g.* 1.125. **4.** *a.* .3125; *b.* .0375; *c.* .225; *d.* .4375; *e.* .12; *f.* .6875; *g.* .8125. **Page 189.** — **6.** *a.* $.37\frac{1}{2}$; *b.* $.43\frac{3}{4}$; *c.* $.23\frac{1}{3}$; *d.* $.46\frac{2}{3}$; *e.* $.18\frac{3}{4}$; *f.* $.31\frac{1}{4}$; *g.* $.36\frac{2}{3}$. **7.** *a.* $.58\frac{1}{3}$; *b.* $.41\frac{2}{3}$; *c.* $.13\frac{7}{11}$; *d.* $.32\frac{1}{7}$; *e.* $.08\frac{3}{4}$; *f.* $.20\frac{5}{6}$; *g.* $.22\frac{1}{12}$. **9.** *a.* .44, .4444; *b.* .78, .7778; *c.* .29, .2857; *d.* .58, .5833; *e.* 3.14, 3.1429; *f.* 6.67, 6.6667; *g.* .32, .3182. **10.** *a.* .73, .7333; *b.* .43, .4286; *c.* .08, .0833; *d.* .56, .5556; *e.* .09, .0909; *f.* .64, .6364; *g.* .18, .1786. **1.** *a.* 4.22; *b.* 12.67; *c.* .03; *d.* .24. **2.** *a.* 7.27; *b.* 6.33; *c.* 77.92; *d.* .69.

3. *a.* 50.67; *b.* .15; *c.* 3.61; *d.* .16. **4.** *a.* .0667; *b.* 83.3333; *c.* .0667; *d.* 22.2222. **5.** *a.* 1.6667; *b.* .1077; *c.* .0015; *d.* .1531. **Page 190.**—**4.** *a.* 1.8; *b.* 2.1; *c.* 1.6; *d.* .9.
5. *a.* 1.5; *b.* 1.23; *c.* 1.45; *d.* .91. **6.** *a.* .138; *b.* .2435; *c.* 2.538; *d.* 2.416. **Page 191.**—**1.** 4¢; 4¢; 10¢; 10¢. **2.** 2¢; 2¢. **3.** 3¢; 3¢; 4¢. **4.** 14¢; 12¢. **5.** 14¢; 16¢; 14¢. **Page 192.**—**1.** 4¢; 4¢. **2.** 3¢; 4¢. **Page 193.**—**3.** 4¢; 2¢. **4.** 2¢; 3¢. **2.** \$7.25. **Page 194.**—**4.** \$3,571,778.72; more. **5.** 5. **6.** 2; \$2.77. **7.** \$1140. **8.** 81. **9.** 750; 1500. **10.** \$4.96; \$4.06; \$4.96. **Page 195.**—**1.** \$103.38.
2. \$133.85. **Page 196.**—**1.** 300. **2.** 300. **3.** 40; 40; 40. **4.** 13; 2; 2. **5.** 8, 3.25, $\frac{1}{2}$, $\frac{1}{2}$; 12.25. **6.** 160, 65, 10; 245; 245. **Page 197.**—**1.** 33.6. **2.** 44.94.
3. 64.46. **4.** 260.76. **5.** 262.37. **6.** 933.72. **1.** .3; .05; .425; .27; .21; .293; .454; .314. **2.** .15; .55; .57; .699; .17; .239; .401; .072. **3.** .04; .47; .001; .25; .05; .091; .612; .002. **4.** .199; .125; .02; .021; .09; .891; .009; .092. **Page 198.**—**5.** .5593; .1244; .1791; .0084; .6001; .0009. **6.** .5282; .2681; .001; 1.5432; 59.287; .0909. **7.** .1889; 6.3268; .2203; 78.114; .6975; .001.
1. .25; .01; .0042; .032; .0042; .0081; .064; .09. **2.** .00009; 11.1; .0081; .1407; .328; .0096; .0375; .00252. **3.** 1.25; .625; .0125; .00528; 75; 176; 2.25; 96. **4.** 1; .04; .0075; 3.75; .5; .02; .06; .35. **5.** .0015; .03; .05; .4; .0144; .24; 70.4; 3.3.
6. .005; .0052; .012; .02; .024; .5; .16; .135. **Page 199.**—**1.** .02; 1; .2; 20; 20; 2000. **2.** .04; .02; .5; 5; .05; .2. **3.** .002; 50; 2; 5; .02; 30. **4.** 900; .5; .5; .2; .2; 200. **5.** .0125; 125; 700; .03; 20; .05. **6.** 25; .05; .05; .02; .005; 50. **7.** 100; .1; .002; .003; 2.5; 5. **8.** .12; .008; .5; .02; 16; 120. **9.** 2; 30; .5; 200; 20; .2. **10.** .2; 400; .075; 20; 2; 20. **3.** .001. **4.** 2.5; \$0.75; 5 lb.; \$0.05. **Page 200.**—**5.** .25; \$0.25; \$0.075; 2.5 lb.; \$5; .6 sec.; 2.4 bu.; .5 gal. **8.** .50; .25; .75; .20; .40; .60; .80; $33\frac{1}{3}$; $.66\frac{2}{3}$; $12\frac{1}{2}$; $37\frac{1}{2}$; $.62\frac{1}{2}$; $87\frac{1}{2}$; $.16\frac{2}{3}$; $.83\frac{1}{3}$; $.08\frac{1}{3}$. **9.** Reading from left to right the products are: 2; 16; 15; 15; $7\frac{1}{2}$; 12; 36; 18; 2; 5; 4; 15; 21; 10; 3; 35. **10.** Reading from left to right: $\frac{1}{10}$; $\frac{1}{4}$; $\frac{1}{2}$; $\frac{17}{20}$; $\frac{3}{10}$; $\frac{3}{4}$; $\frac{4}{5}$; $\frac{9}{10}$; $\frac{3}{5}$; $\frac{1}{5}$; $\frac{2}{5}$; $\frac{7}{10}$; $\frac{1}{3}$; $\frac{2}{3}$; $\frac{3}{8}$; $\frac{7}{8}$; $\frac{5}{8}$; $\frac{1}{6}$; $\frac{1}{12}$; $\frac{5}{12}$. **11.** 5. **Page 201.**—**13.** 2; 3; none. **14.** Reading from left to right: .22; .29; .11; .101; .086; .258; .09; .81; .06; .065; .72; .99; .078; 1.8; .09; 35; 375; .03; \$0.275; .6; .9; .09; 3; .86; 600; 360; .2; 3.2; 6; 1; .45; 1; \$25; .09; 2; 3; 6; .8; .1; 10; 10; .1; 2; .1; 14; 3; 4; 5. **15.** 931 lb. **16.** $.9144^m$; 5.0292^m . **17.** 12.4274. **18.** 80¢. **Page 202.**—**19.** 44; .044 lb. **20.** 1 lb. **21.** 82.41; 13.9; 1.18, 2.51. **22.** 1.18. **23.** 21.312. **24.** See page 101. **25.** See page 106. **26.** \$1.03, correct to the nearest cent. **27.** 300 lb.; \$315; \$10.50. **Page 203.**—**28.** \$5.75. **29.** $\frac{1}{3}$; $\frac{2}{3}$. **30.** 134.40. **31.** 90¢. **32.** 29.9; 26.7. **33.** 1.42¢. **34.** 2¢; \$2.72. **35.** \$200,000,000. **Page 204.**—**36.** \$1.25. **37.** See page 92. **38.** \$78.75. **39.** 6¢. **40.** \$18.75. **41.** 62.5 lb. **42.** \$2.50. **43.** 12.5 bu. **44.** 300 lb. **45.** 1.8¢; \$1.08; 52¢. **Page 205.**—**46.** \$40. **47.** \$0.41205. **48.** \$145. **1.** .4321; .1234. **2.** 16.093; 60.93; 1609.3. **3.** \$18.44. **4.** \$0.002. **5.** \$9; 9¢. **Page 206.**—**10.** \$0.328. **1.** 55.2 lb. **12.** 600. **13.** 100. **14.** \$3. **15.** \$2.70. **16.** \$9.90. **17.** \$8. **18.** 50¢. **Page 207.**—**19.** 90 lb. **20.** \$12,775,000. **21.** \$9,788,500. **22.** 2.1 mills. **23.** 3.937. **24.** 30.48. **25.** 38.4. **26.** \$68.80; \$6.88. **27.** 213.1. **Page 208.**—

28. \$35. 29. \$.01; \$1; \$.01; \$1. 30. 8960. 31. \$4326.66 $\frac{2}{3}$. 32. 777,777,777;
888,888,888. 33. 24. 34. 25¢; \$1.25; \$2.25. 35. 4 $\frac{2}{3}$. 36. 12. 37. 15. 38. 256,000.
Page 209. — 39. 3.875. 40. \$384. 41. \$324,600. 42. 25. 43. 600. 45.
 $\frac{1}{2}$; $\frac{3}{10}$; $\frac{2}{5}$; $\frac{2}{3}$; $1\frac{1}{3}$; $2\frac{1}{2}$. 46. 25¢, 15¢, 10¢. 47. 30¢, 18¢, 12¢. 48. 6¢; $\frac{1}{5}$; $\frac{1}{4}$; $\frac{4}{5}$.
Page 210. — 49. .556, .545, .538, .533; $\frac{1}{15}$, $\frac{1}{13}$, $\frac{1}{11}$, $\frac{1}{9}$. 50. \$.004; 3200.
52. 6, 6, 6; 10, 10, 10. 54. 4 $\frac{2}{3}$; \$2.80. 55. 63. 56. \$12. 57. Norman's by \$30.
58. 7 $\frac{1}{3}$. 59. 3,835,900,000 lb.; 3,649,000,000 lb.; 445,000,000 lb.; 258,100,000 lb.;
329,300,000 lb.; 382,700,000 lb. Page 212. — 1. $\frac{5}{100}$, .05; $\frac{1}{100}$, .45;
 $\frac{8}{100}$, .08; $\frac{1}{100}$, .10; $\frac{5}{100}$, .50; $\frac{7}{100}$, .75; $\frac{10}{100}$, 1.00; $\frac{12}{100}$, .12 $\frac{1}{2}$; $\frac{16}{100}$, .06 $\frac{1}{4}$;
 $\frac{84}{100}$, .08 $\frac{1}{3}$; $\frac{125}{100}$, 1.25; $\frac{74}{100}$, .07 $\frac{1}{2}$; $\frac{200}{100}$, 2.00; $\frac{500}{100}$, 2.50; $\frac{624}{100}$, .62 $\frac{1}{2}$. 3. .20,
 $\frac{1}{5}$; .10, $\frac{1}{10}$; .80, $\frac{4}{5}$; .30, $\frac{3}{10}$; .40, $\frac{2}{5}$; .50, $\frac{1}{2}$; .70, $\frac{7}{10}$; .90, $\frac{9}{10}$; .05, $\frac{1}{20}$; .15, $\frac{3}{20}$;
.75, $\frac{3}{4}$; .60, $\frac{3}{5}$; .45, $\frac{9}{20}$; .55, $\frac{11}{20}$; .85, $\frac{17}{20}$; .65, $\frac{13}{20}$. 5. .12 $\frac{1}{2}$, $\frac{1}{8}$; .62 $\frac{1}{2}$, $\frac{5}{8}$; .87 $\frac{1}{2}$, $\frac{7}{8}$;
.06 $\frac{1}{4}$, $\frac{1}{16}$; .33 $\frac{1}{3}$, $\frac{1}{3}$; .66 $\frac{2}{3}$, $\frac{2}{3}$; .06 $\frac{2}{3}$, $\frac{1}{15}$; .08 $\frac{1}{3}$, $\frac{1}{12}$; .14 $\frac{2}{3}$, $\frac{1}{4}$; .11 $\frac{1}{9}$, $\frac{1}{9}$; .16 $\frac{2}{3}$, $\frac{1}{6}$; .22 $\frac{2}{3}$, $\frac{2}{9}$.
6. 50%; 25%; 20%; 75%; 60%; 80%; 5%; 4%; 2%; 5%; 25%; 35%; 4%;
6%; 75%; 60%; 80%; 45%. 7. 12 $\frac{1}{2}$ %; 37 $\frac{1}{2}$ %; 62 $\frac{1}{2}$ %; 87 $\frac{1}{2}$ %; 33 $\frac{1}{3}$ %; 66 $\frac{2}{3}$ %;
26 $\frac{2}{3}$ %; 8 $\frac{1}{3}$ %; 12 $\frac{1}{2}$ %; 37 $\frac{1}{2}$ %; 62 $\frac{1}{2}$ %; 87 $\frac{1}{2}$ %; 33 $\frac{1}{3}$ %; 66 $\frac{2}{3}$ %; 16 $\frac{2}{3}$ %; 8 $\frac{1}{3}$ %.
Page 213. — 2. a. 3; b. 4; c. 3; d. 2 $\frac{1}{4}$. 3. a. 5; b. 18; c. 28; d. 54. 4. a. 7;
b. 3; c. 3; d. 4. 5. a. \$5; b. \$3; c. \$6; d. 14. 7. a. 2; b. 3; c. 15; d. 35. 8. a. 7;
b. 10; c. 3; d. 5. 9. a. \$3; b. \$2.25; c. \$20; d. \$5. 10. a. \$6; b. \$5; c. \$3; d. \$.07.
1. Suggestion. 50% = $\frac{1}{2}$, 25% = $\frac{1}{4}$, 75% = $\frac{3}{4}$, and 100% = 1. Therefore, name,
in turn, $\frac{1}{2}$ of, $\frac{1}{4}$ of, $\frac{3}{4}$ of, and once each of the given numbers. 2. Suggestion.
33 $\frac{1}{3}$ % = $\frac{1}{3}$, 66 $\frac{2}{3}$ % = $\frac{2}{3}$, and 100% = 1. Therefore, name, in turn, $\frac{1}{3}$ of, $\frac{2}{3}$ of,
and once each of the given numbers. 3. Suggestion. 12 $\frac{1}{2}$ % = $\frac{1}{8}$, 37 $\frac{1}{2}$ % = $\frac{3}{8}$,
62 $\frac{1}{2}$ % = $\frac{5}{8}$, 87 $\frac{1}{2}$ % = $\frac{7}{8}$, and 100% = 1. Therefore, name, in turn, $\frac{1}{8}$ of, $\frac{3}{8}$ of, $\frac{5}{8}$
of, $\frac{7}{8}$ of, and once each of the given numbers. Page 214. — 4. 1; 2; 3.
5. 10; 25; 20; 40; $\frac{3}{5}$. 6. 1; 3; 7; 5; $\frac{1}{2}$. 7. 3; 1; 5; 4; 6; 7; 10. 9. 16; 20; 2;
6; 12; 18; 14; 1; $\frac{1}{2}$; .2. 10. Suggestion. Name in turn, 3 $\times$, 4 $\times$, 1 $\times$, 5 $\times$,
7 $\times$, 8 $\times$, 10 $\times$ each of the numbers in example 9. 11. $\frac{6}{5}$; $\frac{3}{2}$; $\frac{8}{5}$; $\frac{11}{10}$; $\frac{9}{5}$; $\frac{3}{4}$; $\frac{5}{2}$.
13. 9; 15; 30; 3; 4 $\frac{1}{2}$; 45; 7 $\frac{1}{2}$; 10 $\frac{1}{2}$; 37 $\frac{1}{2}$; .6; 60¢. 14. \$5; \$10; \$20; \$25; \$50; $\frac{5}{8}$;
 $\frac{5}{16}$; .5; .1. 15. 150 in.; 375 lb.; 540 A. 1. 20¢; 10¢; \$1; 12¢; 1¢; \$2; \$1.20.
Page 215. — 2. 20. 3. \$4; \$3; \$7. 4. The answers are 1, 2, 3, 4, 5, 6, 7, 8,
9, 10. 5. The answers are 2, 4, 6, 8, 10, 12, 14, 16, 18, 20. 6. \$6; 5 bu.; 2 ft.;
3 yd. 7. Multiply 1% of the number by 2; by 3; by 4; by 5. 8. Suggestion.
Multiply 1% of the given amounts, namely, \$2, 3 men, 8 lb., 5 tons, 10 oz.,
\$1.50, \$2.50 by 2, 3, 4, and 10, in turn, to find 2%, 3%, 4%, and 10% of them.
9. 483; 1127. 10. \$72.30. 11. \$75. 12. 38. Page 216. — 2. 49. 3. 10¢.
4. 3 $\frac{3}{4}$. 8. .50; .25; .075; .125; .375; .625; .875; .027; .065; .003; .06125;
.005. 9. 3.5¢; 36.5 lb.; 125 T. 10. 87; 4; 5; 3.3; .7. 11. 45; 9.72; 8.8%.
Page 217. — 12. 41.25 gr.; 371.25 gr. 13. 240 sq. ft. 1. \$14. 2. 4; 10; 16; 1; 5; 6;
20; 15. 3. 48; $\frac{1}{4}$. 4. 4; 20; 12; 8; 2; 1; 10; 3. 5. 16. 6. \$4; \$8; \$12; 16¢; 20¢; 28¢;
40¢. 7. 16 lb.; 20 lb. 8. 15 yd.; 12 yd.; 9 yd. 9. 20 lb.; 10 lb.; 64 lb. 10. 2¢; 8¢;
4¢; 5¢. Page 218. — 11. Reading from left to right the numbers to be supplied

re: 4; 1; 1; 1; 1; 10. 12. \$6. 13. \$100. 14. 25¢. 15. 20; 2. 2. 3. 3. 3.
 . 24. 5. 24. 6. 60. 7. 600. Page 219.— 8. a. 200; b. 300; c. 300; d. 180.
 . a. 300; b. 400; c. 500; d. 200. 10. a. 528; b. 300; c. 500; d. 900. 11. a. 100; b.
 25; c. 100; d. 20. 12. a. 56; b. 450; c. 200; d. 120. 13. a. 768; b. 200; c. $2\frac{1}{2}$;
 1. $1\frac{1}{2}$. 14. \$10; \$16.66 $\frac{2}{3}$. 15. \$136; \$170. 16. \$350; \$300. 17. 1250. 18.
 3640. 19. 300. 2. $\frac{1}{2}$; 50%. 3. $\frac{1}{3}$; 33 $\frac{1}{3}$ %. 4. $\frac{1}{8}$; 33 $\frac{1}{3}$ %. 5. $\frac{1}{8}$; 33 $\frac{1}{3}$ %.
 Page 220.— 6. a. 25%; b. 12 $\frac{1}{2}$ %; c. 66 $\frac{2}{3}$ %; d. 12 $\frac{1}{2}$ %. 7. a. 75%; b. 25%;
 66 $\frac{2}{3}$ %; d. 87 $\frac{1}{2}$ %. 8. a. 62 $\frac{1}{2}$ %; b. 80%; c. 37 $\frac{1}{2}$ %; d. 8 $\frac{1}{3}$ %. 9. 50%; 12 $\frac{1}{2}$ %.
 0. 3%; 4%; 5%; 10%; 25%. 11. 50%; 33 $\frac{1}{3}$ %; 25%; 66 $\frac{2}{3}$ %; 16 $\frac{2}{3}$ %; 8 $\frac{1}{3}$ %.
 2. 200%; 300%; 150%; 125%. 13. 200%. 14. 400%; 800%. 15. 100%;
 6 $\frac{2}{3}$ %; 50%; 25%; 16 $\frac{2}{3}$ %. 16. 98%. 17. 5%; 8%; 12%; 2%; 12.5%; 7.5%;
 75%; 3.25%; 3.8%. Page 221.— 2. a. 40%; b. 25%; c. 4%; d. 12 $\frac{1}{2}$ %.
 . a. 25%; b. 40%; c. 6 $\frac{2}{3}$ %; d. 60%. 4. a. 8 $\frac{1}{3}$ %; b. 18%; c. 30%; d. 20%.
 . a. 11 $\frac{1}{9}$ %; b. 10%; c. 5%; d. 20%. 7. 4.1%. 8. 15%; 85%. 9. 20%. 10.
 8%. 11. 7.5%. 12. 25%. 13. 16 $\frac{2}{3}$ %. Page 223.— 1. .02, $\frac{1}{50}$; .04, $\frac{1}{25}$; .05,
 .06, $\frac{1}{10}$; .10, $\frac{1}{10}$; .20, $\frac{1}{5}$; .40, $\frac{2}{5}$; .60, $\frac{3}{5}$; .80, $\frac{4}{5}$; .25, $\frac{1}{4}$; .50, $\frac{1}{2}$; .70, $\frac{7}{10}$; .90, $\frac{9}{10}$; .75, $\frac{3}{4}$;
 .25, $\frac{1}{8}$; .375, $\frac{3}{8}$; .625, $\frac{5}{8}$; .875, $\frac{7}{8}$; .075, $\frac{3}{40}$. 2. .04; .12; .15; .18; .28; .42; .65; .82;
 .35; .045; .0365; .0475; .086; .0872; .0656; .0525. 3. $\frac{1}{3}$; $\frac{2}{3}$; $\frac{1}{6}$; $\frac{1}{12}$; $\frac{1}{15}$; $\frac{7}{8}$; $\frac{5}{8}$; $\frac{3}{8}$.
 Page 224.— 18. 100%, 98%, 90%, 96%, 92%, 94%, 0%, 2%, 10%, 4%,
 %, 6% 19. Beauty by 2.33 lb. 1. \$6; 85%; \$34. 2. 40%. 3. 75¢; 75%.
 1.25%; 22.15%; 7.5%; 2.82%; 7.2%. 5. 1.8%. 6. 20%. 7. \$1. Page
 25.— 8. 50%. 9. .99 in. 10. 33 $\frac{1}{3}$ %. 12. 5%. 13. Dime; quarter dollar;
 dime; dime. 14. 40%; 60%. 15. 2%. 16. 50%; 75%. 17. 90%; 60%; 80%;
 0%; 50%. Page 226.— 18. 400%. 19. 600%. 20. 18¢; 225%. 21.
 14 $\frac{1}{3}$ %. 22. 26%. 1. \$10; \$40. 2. \$0.80; \$3.20. 3. \$3; \$12. 4. \$1.60; \$6.40.
 Page 227.— 5. 20¢; 80¢. 6. 60¢; \$2.40. 7. 50¢; \$2. 8. 90¢; \$3.60. 9.
 9; \$36. 10. 30¢; \$1.20. 11. \$12; \$48. 12. \$20; \$80. 13. \$2.40; \$9.60. 14.
 1.20; \$4.80. 15. \$1.80; \$7.20. 16. \$8; \$32. 17. At a reduction of 10%, the
 discounts in examples 1 to 16 are, in turn, \$5, 40¢, \$1.50, 80¢, 10¢, 30¢, 25¢,
 5¢, \$4.50, 15¢, \$6, \$10, \$1.20, 60¢, 90¢, \$4. At a reduction of 50% the dis-
 counts are, in turn, \$25, \$2, \$7.50, \$4, 50¢, \$1.50, \$1.25, \$2.25, \$22.50, 75¢, \$30,
 50¢, \$6, \$3, \$4.50, \$20. 18. The latter; the difference is 30¢. 19. \$4; \$16.
 20. \$15; \$75. 21. \$25; \$25. 22. \$15; \$60. 23. \$8; \$16. 24. \$4; \$28. 25.
 5¢; \$10. 26. \$1; \$11. 27. 70¢; \$2.80. 28. \$40; \$60. 1. 25%. 2. 20%.
 33 $\frac{1}{3}$ %. 4. 50%. 5. 33 $\frac{1}{3}$ %. 6. 12 $\frac{1}{2}$ %. 7. 5%. 8. 10%. 9. 5%. 10. 2%.
 Page 228.— 2. \$361; \$304. 3. \$2975; \$2625. 4. \$24. 5. \$2.25. 6.
 5.06. Page 229.— 7. \$5; \$9. 8. \$324. 9. \$1800. 10. 12 $\frac{1}{2}$ %; \$1.05.
 Page 230.— 3. 100%; 50%. 4. 20%; 25%. 1. Reading from left to right
 the answers are: 1¢, 6¢; \$0.15, \$1.65; 1¢, 9¢; \$0.35, \$1.40; 5¢, 20¢; \$1.01,
 .07; 20¢, 50¢; \$2.70, \$4.50; 4¢, 28¢; \$4, \$10.40; \$1, \$2; \$1.10, \$8.80;
 , \$19; \$1.10, \$8.80; \$25, \$65; \$14, \$2. 2. \$7.80. Page 231.—
 \$2. 4. 10¢. 5. \$4.50; \$3.60. 6. 50¢; \$50. 7. 4. 2. 10¢. 3. \$1.

Page 232. — 4. \$1575. 5. \$2.25. 6. 56¢. 8. 44¢. 1. Reading from left to right the answers are: 100%; 50%; 125%; 50%; 150%; 150%; 200%; 80%; $87\frac{1}{2}\%$; 40%; $87\frac{1}{2}\%$; 100%; $12\frac{1}{2}\%$; $166\frac{2}{3}\%$; 50%; 100%; 200%; 50%; 20%; 50%; 20%; 40%; 75%; 25%; $66\frac{2}{3}\%$; 200%; 10%; 100%; $83\frac{1}{3}\%$; 300%.
 Page 233. — 2. Reading from left to right the answers are: 20%; 1%; $33\frac{1}{3}\%$; $12\frac{1}{2}\%$; 20%; 20%; $37\frac{1}{2}\%$; 5%; $33\frac{1}{3}\%$; 20%; 20%; 25%; 40%; 40%; $12\frac{1}{2}\%$; 25%; 15%; 20%; 5%; 22%; $16\frac{2}{3}\%$; 4%; 12.5%; $16\frac{2}{3}\%$. 3. Gain 25%; gain 50%. 4. Gain 400%; gain 200%. 5. Loss $12\frac{1}{2}\%$; loss 25%. 6. Gain 100%; gain 200%. 7. $66\frac{2}{3}\%$. 8. 50%. 9. 50%. 10. $66\frac{2}{3}\%$. 11. 60%.
 Page 234. — 2. 60%. 3. 200%; 100%; 50%; 75%. 4. $66\frac{2}{3}\%$; 40%. 5. $87\frac{1}{2}\%$. 6. 20%; $16\frac{2}{3}\%$. 7. 25%; 75%. 8. Selling price. Page 235. — 1. \$2.50. 2. \$89.25. 3. \$9.60. 4. \$120. 5. \$20.50. 6. \$31.50. 7. \$1.50. 8. \$146.80.
 Page 236. — 9. \$150. 10. \$86.10. 11. 2%. 12. \$9469.75. 13. \$9.
 Page 237. — 1. \$5. 2. \$6; \$7. 3. \$10; \$12. 4. \$2. 5. \$25; \$12.50. 6. \$36. 7. \$30. 8. \$84. 9. \$96. 10. \$9. 11. \$9. 12. \$37.80. 13. \$27.50. 14. \$27. 15. \$211.25. 16. \$93.75. 17. \$75. 18. \$49.50. 19. \$22.50. 20. \$42. 21. \$102.50. 22. \$56.25. 23. \$48. Page 238. — 2. \$2. 3. \$1.20. 4. \$4.50. 5. \$1.17. 6. \$4. 7. \$0.90. 8. \$5.83. 9. \$2.50. 10. \$0.67. 11. \$1.33. 12. \$1.44. 13. \$9.84. 14. \$4.20; \$3.85. 15. \$6.50; \$7.80. 16. \$5.35; \$6.88. Page 239. — 1. \$26.50; \$26.47. 2. \$34; \$33.96. 3. \$13.33; \$13.25. 4. \$42.50; \$42.25. 5. \$52; \$51.78. 6. \$17.50. 7. \$40. 8. \$212.50.
 Page 240. — 2. Dec. 1, 1921; at the Union National Bank of Wilmington. 3. \$3. 4. May 1; Sept. 1; Dec. 1. 5. Aug. 30. Page 241. — 6. May 31; June 30. 7. William Brown; \$103; William Brown. 8. \$20.30. 9. \$8.21. 10. Feb. 28, 1921. Page 242. — 1. Norman C. Cameron. 2. See form p. 242; write your own name where the name of Norman C. Cameron appears, and the name of your classmate where that of George P. Thompson appears. 3. See indorsement, page 242. Page 244. — 2. 1155. 5. 24. 6. 32. 7. 64. 9. \$1.10. 10. 100; see statement following problem 6, page 121. 11. \$21.
 Page 245. — 12. See page 280. 15. 4 A.M.; noon; 3 P.M. 2. 12. 3. 8 P.M.; 8 A.M.; 2.15 A.M. 7. 1760; 5280. 8. 12,000; 30,000. Page 246. — 10. 5; $4\frac{5}{8}$. 11. 1.15. 13. 4849; 43,565. 15. See answer to 13, also Table, page 280. 1. 3¢; \$1.80. 2. 2¢; \$2. Page 247. — 4. 18,240.81. 5. 3.45. 8. \$50.40. 9. \$14.64; \$30.50. 10. \$27.75; \$50.88. 11. \$3.85; \$4.13. 12. \$29.80.
 Page 248. — 3. 114 oz.; $7\frac{1}{8}$ lb. 4. 88 cwt.; 4.4 T. 5. 105 hr.; $4\frac{3}{8}$ da. 6. 500 sq. rd.; $3\frac{1}{8}$ A. 7. 51 qt.; $12\frac{3}{4}$ gal. 8. 660 rd.; $2\frac{1}{16}$ mi. 9. 35 pk.; $8\frac{3}{4}$ bu. 10. 69 yd.; $12\frac{6}{11}$ rd. 11. 23 bu. 1 pk.; 744 qt. 12. 30 gal. 1 qt.; $30\frac{1}{4}$ gal. 13. 62 lb. 8 oz.; $62\frac{1}{2}$ lb. 14. 7 hr. 30 min.; 27,000 sec. 15. 2 T. 675 lb.; 46.75 cwt. 16. 12 rd. 2 yd.; 204 ft. 17. 33ft. 4 in. Page 249. — 4. 16 ft. 10 in. 5. 29 ft. 1 in. 6. 16 A. 100 sq. rd. 7. 18 A. 150 sq. rd. 8. 17 hr. 40 min. 10 sec. 9. 21 yr. 6 mo. 14 da. 10. 1972 yr. 3 mo. 2 da. 11. 1 ft. 6 in. 12. 102 ft. 11 in. 13. 5 T. 17 cwt. 14. 27 A. 70 sq. rd. 15. 6 hr. 17 min. 32 sec.

16. 3 da. 19 hr. 55 min. 17. 65 yr. 8 mo. 23 da. Page 250. — 1. Oct. 24, 1852. 2. 67 yr. 9 mo. 22 da. 3. 7 ft. 2 in. 4. 1897 lb. 7. 11 hr. 45 min. 9. 1 ft. 11 in. 10. 1 hr. 33 min. 11. 10.55 A.M. Page 251. — 12. 8.40 A.M. 13. 12 hr. 15 min. 14. 9 hr. 35 min. 3. 17 ft. 6 in. 4. 34 gal. 2 qt. 5. 20 bu. 6. 75 ft. 7. 18 A. 120 sq. rd. 8. 14 T. 1250 lb. 9. 16 hr. 1 min. 30 sec. 10. 20 yr. 4 mo. 24 da. Page 252. — 11. 3 gal. 1 qt. 12. 8 ft. 4 in. 13. 1 A. 90 sq. rd. 14. 3 bu. 1 pk. 15. 8 wk. 4 da. 16. 2 A. 88 sq. rd. 17. 3 hr. 12 min. 14 sec. 18. 3 yr. 8 mo. 20 da. 19. \$4. 20. 55. Page 253. — 9. *r* and *s*, also *t* and *u*. 2. Equal. 3. 8 yd. 4. 40 ft. 5. 20 yd. 6. Right angles. Page 254. — 7. 9; 9; 9. 8. 100. 9. 144; 2.25; 6.25; 21.16. 10. 480 ft. 11. 400. 12. 40. 1. 4; 2. 2. 4 right angles. 3. Equal. Page 255. — 4. 20 ft. 5. 120 ft. 6. 12; 12; 12. 7. 360. 8. 56. 9. 1000. 10. 12. 11. 5. 12. 1. 13. 43,560; $\frac{5}{12}$. Page 256. — 2. 8 in.; 7 in. 3. 25 in. 4. 40 ft. 5. 10 ft. 6. 20 ft. 7. 2 yd. 8. $1\frac{1}{2}$ ft. 9. 10 ft. 10. 100 ft. 11. 20 yd. Page 257. — 2. 50 ft. 3. 150 ft. 4. \$2500. 5. 50 ft.; 50 ft.; 25 ft. 6. 7500; 7500. 7. $\$0.26\frac{2}{3}$. 8. 6220. 9. \$80. Page 258. — 1. 10 ft.; 10 ft. 2. 1 in. = 4 ft. 3. 40 ft. 4. 6 in. 5. 19. 6. \$1.52. Page 259. — 7. 118. 8. 11 and 8 over. 9. 18. 10. 118. 11. \$1.08. 12. \$1.20. 13. 40. 14. 19 and 2 of each. over. 15. 40¢. 16. 10. Page 261. — 2. 8 ft. 3. 32 ft. 4. 12 ft.; 4 ft.; 4 ft. 5. Reading downward and from left to right: 9600; 12,000; 18,000; 4800; 3200; 6400. 6. 1 in. = 160 ft. Page 262. — 7. 25 sq. yd. 8. 36 sq. rd. 9. .06 sq. mi. 10. 30.25 sq. rd. 11. 15.75 sq. rd. 12. 10.8 sq. rd. 2. A B; A B. 3. Equal. 4. 18; 9. 5. 42 ft. Page 263. — 6. 12 ft. 7. 30 sq. ft. 8. 11 sq. yd. 9. 75 sq. rd. 10. 15.6 sq. rd. 11. 28.4375 sq. rd. 12. .0625 sq. mi. 13. A, 6 sq. rd.; B, 10 sq. rd.; C, 7.5 sq. rd.; D, 12 sq. rd.; E, 12 sq. rd. 2. 3; 3. 3. The lines represented by 4 and 2. 4. 4 and 2. Page 264. — 5. 18. 6. $\frac{1}{2}$. 7. 9. 8. 84 sq. ft. 9. Reading downward and from left to right: 5 sq. rd.; 6 sq. rd.; 8 sq. rd.; 10.5 sq. rd.; 16 sq. rd. Page 265. — 2. 6. 3. 7. 4. 8. 5. 30. 6. 64. 7. \$128. 8. \$63. 9. \$7.20. 10. \$20. 11. 63; \$9.45. Page 266. — 1. 56. 2. 146. 3. 188. 4. 2444. 5. \$18.50. 6. \$54.60. 7. 12. 8. \$64.05. Page 267. — 10. 11. 11. 12. Page 268. — 1. 16. 2. 28. 3. 24. 4. 120. 5. 120. 6. 128. 7. 64. 8. 48. 9. 80. 10. 480. 11. 240. 12. 8. 13. \$14.40. 14. \$36. 15. \$17.28. 16. \$74.67. 17. \$0.86. 18. \$43.20. Page 270. — 1. 128. 2. 11,520. 3. 240. 4. The standard cord is 8 ft. long, 4 ft. wide and 4 ft. high. 6. 76.8. 8. 864. 9. 24. 10. 14.58. 11. 24.75. 12. $6\frac{3}{4}$. Page 271. — 1. $102\frac{2}{7}$; 576. 2. \$103.89. 3. 3184 lb. 4. \$382.08. 5. \$278.89. 6. \$103.19. 7. 1.06 lb. 8. 321.75; 107.25. 9. \$6.01. 10. \$13.53. Page 272. — 1. \$2.70; 9.75 oz. 2. 21¢. 3. 8, and 10¢ over. 4. \$2.50; \$11.50. 5. \$4.80; 16¢. 6. \$4.20; 21¢. Page 273. — 1. 43¢; \$2.57. 2. \$8.50. 3. \$7.40. 4. \$6.79. 5. \$1.95. Page 274. — 2. *a*. 1, 0, $\frac{1}{4}$, 1; *b*. $\frac{5}{4}$, $\frac{1}{4}$, $\frac{1}{5}$, 2; *c*. $\frac{7}{8}$, $\frac{1}{8}$, $\frac{3}{16}$, $1\frac{1}{3}$; *d*. $1\frac{1}{8}$, $\frac{1}{8}$, $\frac{5}{16}$, $1\frac{1}{4}$; *e*. $1\frac{5}{8}$, $\frac{1}{8}$, $2\frac{1}{2}$, $1\frac{1}{6}$; *f*. $\frac{5}{6}$, $\frac{1}{2}$, $\frac{1}{6}$, 4; *g*. $1\frac{1}{8}$, $\frac{1}{8}$, $1\frac{5}{2}$, $1\frac{2}{3}$; *h*. $1\frac{1}{2}$, $\frac{1}{6}$, $\frac{5}{9}$, $1\frac{1}{4}$. 3. *a*. $\frac{5}{6}$, $\frac{1}{6}$, $\frac{1}{6}$,

$1\frac{1}{2}$; $b. 1\frac{1}{6}, \frac{1}{6}, \frac{1}{3}, 1\frac{1}{3}$; $c. 1, \frac{1}{2}, \frac{3}{16}, 3$; $d. 1\frac{1}{4}, \frac{1}{2}, \frac{2}{3}, 2\frac{1}{3}$; $e. 1\frac{1}{6}, \frac{1}{2}, \frac{5}{18}, 2\frac{1}{2}$; $f. 1\frac{1}{4}, \frac{5}{24}, \frac{2}{3}, 1\frac{1}{2}$; $g. 1\frac{5}{12}, \frac{1}{2}, \frac{1}{2}, 1\frac{1}{8}$; $h. 1\frac{1}{10}, \frac{3}{10}, \frac{7}{25}, 1\frac{3}{4}$. 4. $a. 1\frac{1}{10}, \frac{1}{2}, \frac{6}{25}, 2\frac{2}{3}$; $b. 1\frac{1}{20}, \frac{9}{20}, \frac{4}{10}, 2\frac{1}{2}$; $c. 1\frac{13}{20}, \frac{3}{20}, \frac{2}{40}, 1\frac{1}{5}$; $d. 1\frac{1}{24}, \frac{1}{24}, \frac{7}{48}, 5\frac{1}{4}$; $e. 1\frac{1}{24}, \frac{1}{24}, \frac{3}{48}, 1\frac{1}{20}$; $f. 1\frac{5}{24}, \frac{1}{24}, \frac{5}{16}, 2\frac{2}{9}$; $g. \frac{3}{4}, \frac{5}{12}, \frac{7}{72}, 3\frac{1}{2}$; $h. 1\frac{1}{4}, \frac{5}{12}, \frac{2}{72}, 2$. 5. $a. 1\frac{5}{9}, \frac{2}{9}, \frac{1}{27}, 1\frac{1}{3}$; $b. 1\frac{1}{9}, \frac{2}{9}, \frac{8}{27}, 1\frac{1}{2}$; $c. \frac{5}{18}, \frac{1}{18}, \frac{1}{54}, 1\frac{1}{2}$; $d. 1\frac{7}{18}, \frac{5}{18}, \frac{2}{54}, 1\frac{1}{2}$; $e. 1\frac{7}{12}, \frac{1}{12}, \frac{5}{8}, 1\frac{1}{9}$; $f. 1\frac{1}{4}, \frac{7}{24}, \frac{4}{9}, 1\frac{1}{2}$; $g. 1\frac{2}{3}, \frac{1}{6}, \frac{1}{16}, 1\frac{1}{9}$; $h. 1\frac{1}{3}, \frac{7}{30}, \frac{3}{5}, 1\frac{7}{20}$. 6. $a. \frac{7}{16}, \frac{1}{16}, \frac{3}{64}, 1\frac{1}{3}$; $b. \frac{1}{16}, \frac{1}{16}, \frac{3}{64}, 2\frac{1}{4}$; $c. 1\frac{1}{16}, \frac{7}{16}, \frac{1}{64}, 2\frac{2}{5}$; $d. \frac{1}{16}, \frac{5}{16}, \frac{3}{32}, 2\frac{2}{3}$; $e. 1\frac{1}{4}, \frac{1}{4}, \frac{3}{8}, 1\frac{1}{2}$; $f. \frac{5}{8}, \frac{1}{8}, \frac{7}{48}, 2\frac{1}{3}$; $g. 1\frac{3}{4}, \frac{7}{24}, \frac{5}{96}, 1\frac{7}{15}$; $h. \frac{2}{30}, \frac{1}{30}, \frac{1}{5}, 2\frac{2}{9}$. 7. $a. 2\frac{1}{80}, 1\frac{7}{80}$; $b. 3\frac{7}{48}, 1\frac{6}{40}$; $c. 3\frac{1}{15}, 1\frac{1}{44}$; $d. 3\frac{1}{24}, 1\frac{1}{44}$; $e. 4\frac{1}{6}, 3\frac{1}{6}$; $f. 3\frac{7}{12}, 1\frac{1}{4}$; $g. 4, 2\frac{1}{24}$; $h. 3\frac{1}{15}, 2\frac{9}{20}$. 10. The drawing should be 2" by 3"; 96. 11. \$1.12 $\frac{1}{2}$. 12. 64. 13. 889. Page 275. — 14. 360. 16. 1296. 17. Hundredths; thousandths. 18. Tenths; units. 19. \$24. 21. $\frac{5}{8}, 62\frac{1}{2}\%$; $\frac{7}{8}, 87\frac{1}{2}\%$; $\frac{1}{3}, 33\frac{1}{3}\%$; $\frac{2}{3}, 66\frac{2}{3}\%$; $\frac{1}{2}, 8\frac{1}{3}\%$; $\frac{1}{5}, 6\frac{2}{3}\%$. 22. .7143, .8182, .8462, .8667, .9048, .9259, .9355, .9429 23. .0004; .0004; .04; .00004. 24. .42993; 6.07824; .6075. 25. 5.88432; 1.86264; 7.49856. 26. .1; .1; 1. 27. 10; 10; 100; 10; 1000. 28. 2; 3740; .024. 29. 18; .016; 760. Page 276. — 30. \$2.10. 31. $\frac{4}{11}$. 32. \$6.30. 33. 2 $\frac{1}{2}$ oz., 25 gal., $\frac{1}{2}$ lb.; 10 oz., 100 gal., 2 lb. 34. 95%; 90%; 100%; 85%; 80%. 35. 12. 36. 212 lb. 37. 718.08. 38. 2 $\frac{1}{2}$. Page 277. — 39. 525 lb. 40. 45; 90%. 41. \$102.60; \$111.32. 42. \$1.54. 43. 48. 45. \$8. 46. 1 lb. 11 oz. 47. $a. \$15$; $b. \$7.50$; $c. \$2.50$; $d. \$20$. 48. \$60. 49. 19.2. Page 278. — 50. \$75. 51. 5 ft. 52. \$2.60 53. \$1.80. 54. \$47,940,000. 55. 153,776.4; 7115.52. 56. \$25.585. 57. 8 T 58. \$9.40. Page 279. — 59. \$200; 98%. 60. \$33. 61. $\frac{1}{2}$; $\frac{1}{4}$; 100; 50 62. \$3.96. 63. 1 $\frac{1}{3}$ sq. ft



